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CONTENTS

Paint Testing Bureaus

In the report of the test committee of the Master Painters' Association, O. P. Wilkins, chairman of the committee, suggested the idea of establishing paint testing bureaus throughout the country whereby the various samples of paint may be tested under varying climatic conditions, and in this way a comprehensive study can be made of various paints. This has already been started by the committee sending to five members of the association various samples to be exposed and tested under similar conditions. If such a bureau could be permanently established it would be of great value to the association and the railways at large.

Service Tests of Locomotives

In this issue will be found reports of two comparative road tests of locomotives. In one case they were made to determine the economy of the superheater and brick arch, and in the other to determine the economy of one type of freight locomotive as compared with an entirely different type. Tests of this simple character are of decided importance from an operating standpoint, although hardly accurate or complete enough to be of any considerable value to a designer. Since, however, it is the every day service of the locomotive on the road and the amount of fuel and water it requires to do the desired work that counts, such tests, which can be easily made by any company and do not require any elaborate facilities or apparatus, are of great practical value and should be more frequently undertaken.

The Prize Winner

G. H. Roberts, machine foreman of the Long Island Railroad, at Richmond Hill, N. Y., has been awarded the first prize of $25 in the competition on repairs to pistons, piston rods and crossheads, which closed September 1. Mr. Roberts describes methods installed by him in another large eastern railway shop. His article, together with a contribution from C. L. Dickert, assistant master mechanic, Central of Georgia, Macon, Ga., is given in this issue. In awarding the prize to Mr. Roberts, the judges took into consideration the difference of design of the parts and in the equipment available for repairs. While Mr. Dickert's time for the different operations is lower than Mr. Roberts', it was decided that under the conditions, and in view of the fact that Mr. Robert's description was much more comprehensive, his was the more valuable contribution.

Steel Box Cars

The decision of the Pennsylvania Railroad to use a wooden lining in its latest design of steel freight cars was reached after a most careful study of conditions, the consultation including representatives of the different departments of the road as well as shippers. The design is such, however, that if it seems advisable for certain traffic under certain conditions a steel lining can be used without any material change in the present framing. These cars follow the principle incorporated in the steel passenger cars on that road, in the use of a strong center sill to which the weight of the car body and part of the lading is transferred through the medium of two sets of cantilevers, set somewhat inside of the center plates, and the end sills. The use of pressed steel members for the side posts and braces permits the use of a joint that is equivalent in strength to the rest of the member without extra parts or complication. By using very heavy floor boards, intermediate longitudinal sills were made unnecessary, thus saving considerable weight.

The design of the roof is one of the most interesting features of the car. Thin plates, with butt joints, resting on steel carlines which are spaced without reference to the side posts, form the roof structure. The joint of the sheets comes midway be-

tween the carlines and the top cover plate is ridged to lend stiffness to the structure. The design and arrangement of the eaves are such that there can be no entrance of rain or snow through the narrow ventilation opening between the roof sheet and the side plate. A roof built up in this form can be removed intact with very little difficulty. A steel frame house car of this kind approaches a steel passenger car in rigidity and strength, and there would seem to be no reason why the roof made up of thin steel plates with riveted joints will not be thoroughly satisfactory.

Another interesting feature of the car is found in the steel door, wherein spot welding has been freely used in place of riveting. This door is securely held in place at each of its four corners, no matter what its position may be.

Master Painters' Association

The forty-third annual convention of the Master Car and Locomotive Painters' Association, held in Denver, Colo., September 10-13, cannot justly be said to be one of the best conventions the association has ever held. It seems that the members were not very willing to present the papers requested of them, and that the secretary had considerable difficulty in getting together a sufficient number of papers. If the association is to maintain its previous record and standing the members should not hesitate to do all in their power to make it a success, and this demands co-operation. While it may be hard for many of them to express themselves clearly on paper, they should make a special effort to do so, even if the secretary finds it necessary to edit or rewrite the reports after they are sent in.

The papers should be written in sufficient time to allow the secretary to have them printed and distributed to the members fully two weeks before the association meets. In this way they will have ample opportunity to thoroughly analyze them so that any disputable or questionable points may be brought up during the convention and thoroughly threshed out. Last year advance copies were sent out and the discussions were very good, but this year with no advance copies it was noticeable that the discussions were restricted to one or two points that a listener happened to pick out in each paper as it was read. The fact that the test committee's report, one of the best ever presented to the association, received no discussion, clearly brings out the value of the advance copies, for many questions were asked the committee privately, outside of the convention hall, by members who, if they had had an opportunity to read the paper before the convention, would have brought them up during the sessions to the advantage of all the members present.

The attendance was exceptionally good considering the distance the majority of the members had to travel, but care should be taken not to select such extreme meeting points every year, for it is a big question as to whether the members will travel as far every year. Although their transportation is free in most cases, there is considerable expense attached to the long trips. In deciding the next place of meeting, would it not be advisable to choose a more centrally located city?

Air Brake Hose

The last revised specifications of the M. C. B. Association for air brake hose seemed to insure a satisfactory product up to a comparatively recent time. In the last few years, however, complaints about the quality of air brake hose have been very general and in considerable volume, and it is evident that the present specifications do not insure a hose suitable to meet present conditions. A committee of the M. C. B. Association is now working on new specifications and will report at the next convention. Tests and records in the past have indicated that mechanical injury was the chief cause of hose failure, but at a meeting of the Rubber Conference, recently held in New York, it appeared that there was another factor in the failure of air hose which is of even greater importance. Careful inspection and tests of over 22,000 pieces of condemned air hose which were taken from the cars of a large number of railways and were collected from a number of different points showed that porosity was responsible for 82 per cent. of the removals, while mechanical injury of any kind was responsible for but slightly over 10 per cent. This information was received with considerable surprise and is a much stronger argument in favor of revising the specifications than are the failures from mechanical injury, which in many cases can be corrected by a revision of the design of the attachments or in the method of handling. The hose examined which showed porosity was tested by the underwater method and an examination of the inside of a large number of pieces showed the porous condition to have no regular location. In some cases it covered the whole hose and in others it was local and at various points. The rubber manufacturers did not seem to be able to offer an explanation or correction for this difficulty, although it appeared that in general it was probably due to the use of shoddy and ingredients which deteriorate after a few months' service.

Although the specifications call for three hand made calenders for the tube, it is probable that in most cases this requirement is not carried out and the tube is made in one piece. If that is the case and a large amount of shoddy, the principle source of which is now worn out automobile tires, is used, it is quite possible that the very small pieces of flint which have worked into the rubber of the tire will appear in the tube and after constant bending, stretching and contraction that the hose undergoes in service, these small particles will cut microscopic holes throughout the whole tube, making it porous. Even if this quality of material was used, but the tube was made in three calenders, this difficulty would probably quite largely disappear. It has therefore been suggested that the center calnder be made of a different color so that when a tube is cut it will be readily apparent to the inspector that the three calenders have been used.

Among the other features that have been suggested as being advisable to be included in the new specifications in order to insure a better quality of material are the increasing of the stretching tests of the 2-inch marks from 8 in. as at present to 12 in., and the insertion of a tensile strength requirement. In one case, at least, a strength of 1,400 lbs. per sq. in. has been suggested. The increasing of the stretching test is to insure against over cured material while the tensile strength requirements will insure against under cured rubber.

Locomotives on the Santa Fe

There is probably no railway company in the country that has a larger number of different types and classes of locomotives than the Santa Fe, nor is there any which has a larger variety of conditions for the locomotives to meet. This company has been noted for years for its willingness to experiment with a new design which seemed to offer an opportunity for improvement in either power or efficiency, and it has now, or has had in operation, an example of practically every suggested advance in locomotive design that has been developed during the past ten years. In view of these facts, the locomotives recently delivered, which include four types, are suggestive of what experience, under the conditions on that road, has indicated to be the best arrangement. These locomotives, however, should not be accepted as conclusive on these features, since they are intended for only certain districts and probably would not fulfill the requirements at other points. Nevertheless the application of a high temperature superheater to all except the switching engines shows that the low degree superheater has not been found as economical as was expected, all things being considered. Again the purchase of locomotives of the Santa Fe type fitted with simple cylinders and a superheater instead of the tandem compound cylinders previously used, checks the re-

sults on other roads where compounds have been discarded for superheater simples. It also indicates the conclusion that locomotives of this type are preferable to small Mallets, coinciding with the experience of the Chicago, Burlington & Quincy.

The retention of the balanced compound feature of the Pacific type is particularly interesting, since this company has had a large number of balanced compounds in operation for a number of years, and is practically the only one that has retained the design after a trial. It will be noted that a superheater has been applied. The decision to apply radial stay fireboxes to all of this order of locomotives can be subjected to different interpretations. There are now over two hundred locomotives fitted with sectional fireboxes in operation on this road, and all reports that have been given out have been distinctly favorable. Such troubles as are generally known to have occurred, seem to have been in the matter of design rather than in principle. It, however, appeared wise to the management to await further experience with those of the sectional type now in service before applying more. All things considered this order of locomotives is designed along very sound and conservative lines, and includes nothing of an experimental nature.

Wood Working Tools for Car Shops

On page 509 L. R. Pomeroy presents in a characteristic manner a study of the work performed by each tool in a shop making repairs to 70 wooden passenger cars and 714 freight cars per month. This, so far as we know, is the first time that any information of this kind has been published or even collected. About three years ago, Mr. Pomeroy made a somewhat similar study of the metal working tools to be used in the Scranton shops of the Delaware, Lackawanna & Western. This was published in the *American Engineer and Railroad Journal* in April, 1909, and was based on the performance the tools could fairly be expected to give. The present study, on the other hand, is based on what the tools are actually doing in a well organized shop which has been in operation for a number of years and clearly shows the value of a study of this character preliminary to the selection of the tools, their arrangement or the designing of the buildings.

Locomotive Boiler Tests

Designers of locomotive boilers have always been handicapped by the lack of exact data as to the relative value of firebox and tube heating surface. There have been numerous attempts to evolve an equation to express the relation of the two, based on experience with different arrangements and proportions of existing boilers. One of the best known of these, which was accepted and generally used for several years, was put forth by H. H. Vaughan in a paper before the Western Railway Club. He stated that by dividing the total tube heating surface of the boiler by the square root of the length of the tubes the quotient would be an amount of heating surface, each square foot of which would be equivalent to a square foot in the firebox. In other words, in a boiler with 16 ft. flues the firebox heating surface was four times as valuable as tube heating surface, with 20 ft. flues it would be nearly four and a half times as valuable, and with 25 ft. flues, it would be five times as valuable. This equation seemed to fit the conditions fairly well for some time, but was finally shown to be inaccurate. The indications were that the divisor was not large enough and that actually the firebox was more valuable than was indicated. Since that time boiler designers have generally decided this question for themselves and each uses his own formula.

When it was announced that comparative tests were to be made at Coatesville between two boilers, one a radial stay and the other of the sectional type, and that each was first to be tested with the firebox and barrel of the boiler separated from each other so far as water and steam were concerned, it seemed that the exact information so long desired would be obtained. These tests have now been completed, and although the complete report has not been issued, a paper prepared by a representative of the company that furnished the facilities for making the tests, presented at the last meeting of the New York Railroad Club, contains some of the results. It appears that with oil fuel the firebox in the boilers did from 40 per cent. to 50 per cent. of the total work; with long flame coal the firebox did from 33 per cent. to 48 per cent., while with short flame coal it did about 8 per cent. less. The tests in this respect are summed up by stating that a square foot of firebox surface is equivalent to 7.6 sq. ft. of tube heating surface. These boilers had 290 2¼ in. tubes, 18 ft. 2 in. in length over the tube sheets. The total heating surface of the radial stay boiler was about 3,003 sq. ft., of which 245.3 sq. ft., or about 8 per cent., was in the firebox.

Inasmuch as these tests were made primarily for the purpose of comparing the two types of fireboxes and not for determining the relative value of the firebox and tube heating surface, the methods employed introduced conditions not present in a normal boiler, such as the cutting off of the circulation between the barrel and the firebox, and the interjection of cold water through a perforated tube directly over the crown sheet. It is probable that this relation of the value of the two surfaces does not exactly express the facts under normal conditions. It probably, however, is not very greatly in error and shows beyond doubt that the firebox heating surface is considerably more important than has been generally believed. It checks the results that have been obtained with combustion chambers where it has been found that the cutting out of from 700 sq. ft. to 800 sq. ft. of tube heating surface and replacing it with about one-tenth as much firebox heating surface, does not reduce the boiler capacity.

Some other results of the tests quoted in the paper show the possibilities of boiler capacity. With a combustion of 119 lbs. of coal per sq. ft. of grate per hour, 1,669 boiler horse power was developed, or one boiler horse power for 1.8 sq. ft. of total heating surface. This required an evaporation of 19.13 lbs. of water per sq. ft. of heating surface per hour which was equivalent to 8.78 lbs. of water per pound of coal. Under these conditions the over-all thermal efficiency of the boiler was more than 65 per cent. The economy of the brick arch was also clearly proved in these tests.

NEW BOOKS

International Railway Fuel Association. Proceedings of the Fourth Annual Convention, Chicago, May 22-25, 1912. Bound in paper. 315 pages, illustrated. Published by the association, C. G. Hall, C. & E. I. R. R., McCormick building, Chicago, Secretary. Price, 50 cents.

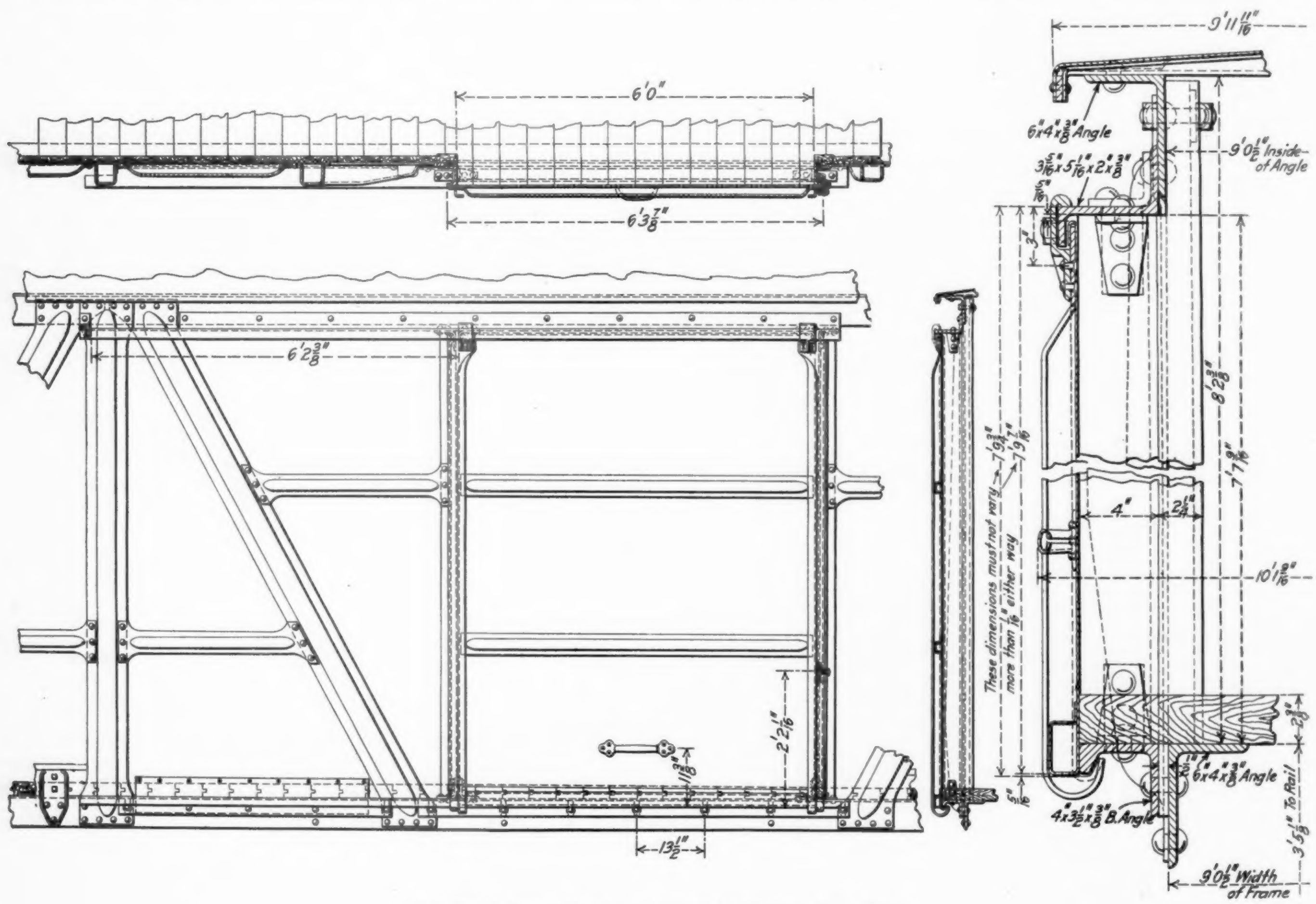
The deliberations of this association at its last convention were of particular interest and importance. This is especially true in connection with instructive methods for improvement in locomotive firing. There is probably no feature of locomotive operation that presents as great opportunities for improvement as in the methods employed by the firemen. A number of roads are actively taking up this subject, and the methods being used on some of the more progressive were fully illustrated and demonstrated at this meeting. Other important subjects discussed were the inspection of fuel, the use of anthracite coal, and locomotive drafting. In the latter paper, H. B. MacFarland, engineer of tests, Santa Fe, presented some startling figures in connection with the amount of power consumed by back pressure on a locomotive. He also gave preliminary figures of some experiments he is making with artificially induced draft. Dr. W. F. M. Goss presented a paper on the subject of fuel as a factor in locomotive capacity, in which he outlined a locomotive that possibly may be required in the future, which had 150 sq. ft. of grate area. Each subject aroused most active and valuable discussion, all of which is included in the proceedings. A list of members with their addresses has also been inserted in this volume.

New Box, Stock and Refrigerator Cars

Steel Frame Freight Equipment With Steel Roofs
The Framing is Suitable For Three Types of Cars.

In harmony with the decision to eventually have all of its cars of the all-steel type, a freight car, the framing of which can be used practically without change for either box, stock or refrigerator cars, has been designed in the mechanical engineer's office of the Pennsylvania Railroad. The all-steel design is not feasible for the two latter types of cars, and in considering the box car design, the advisability of the use of steel was taken up with the transportation, traffic, claim and other departments of the railway, as well as with a number of shippers. The decision arrived at from this discussion favored the use of a wooden floor and a wooden lining, and the new box cars are being built in this manner. If at any time it seems desirable to use a steel inside finish, it can be substituted without material change in the structure.

The box car thus consists of a steel underframe of the fish-belly center sill type, but differing from previous designs as will be explained later; steel side framing formed of posts and braces in pressed shapes secured to angles at the top and bottom; an all-steel roof made up of steel carlines and steel roof sheets, the latter having riveted butt joints with an outside and inside cover plate; a 2⅜ in. tongue and grooved wooden floor and a 1¼ in. tongue and grooved side and end lining on the inside of the posts and with the joints running vertically. The stock and refrigerator cars differ from this only in the lining. The box cars have sliding all-steel doors of special design, while the stock and refrigerator cars have flush doors. All cars now being built are carried on standard arch bar trucks, having 5½ in. x 10 in. journals. The box and stock cars have an inside length of 40 ft. 6 in., a width of 8 ft. 10 in. and a clear height inside of 8 ft. The maximum width over the eaves is 9 ft. 11½ in., and the total length of car outside of end sills is 42 ft. 6 in The top of the floor is 3 ft. 7½ in. above the top of the rail.



All-Steel Door Used on the Steel Frame Box Cars.

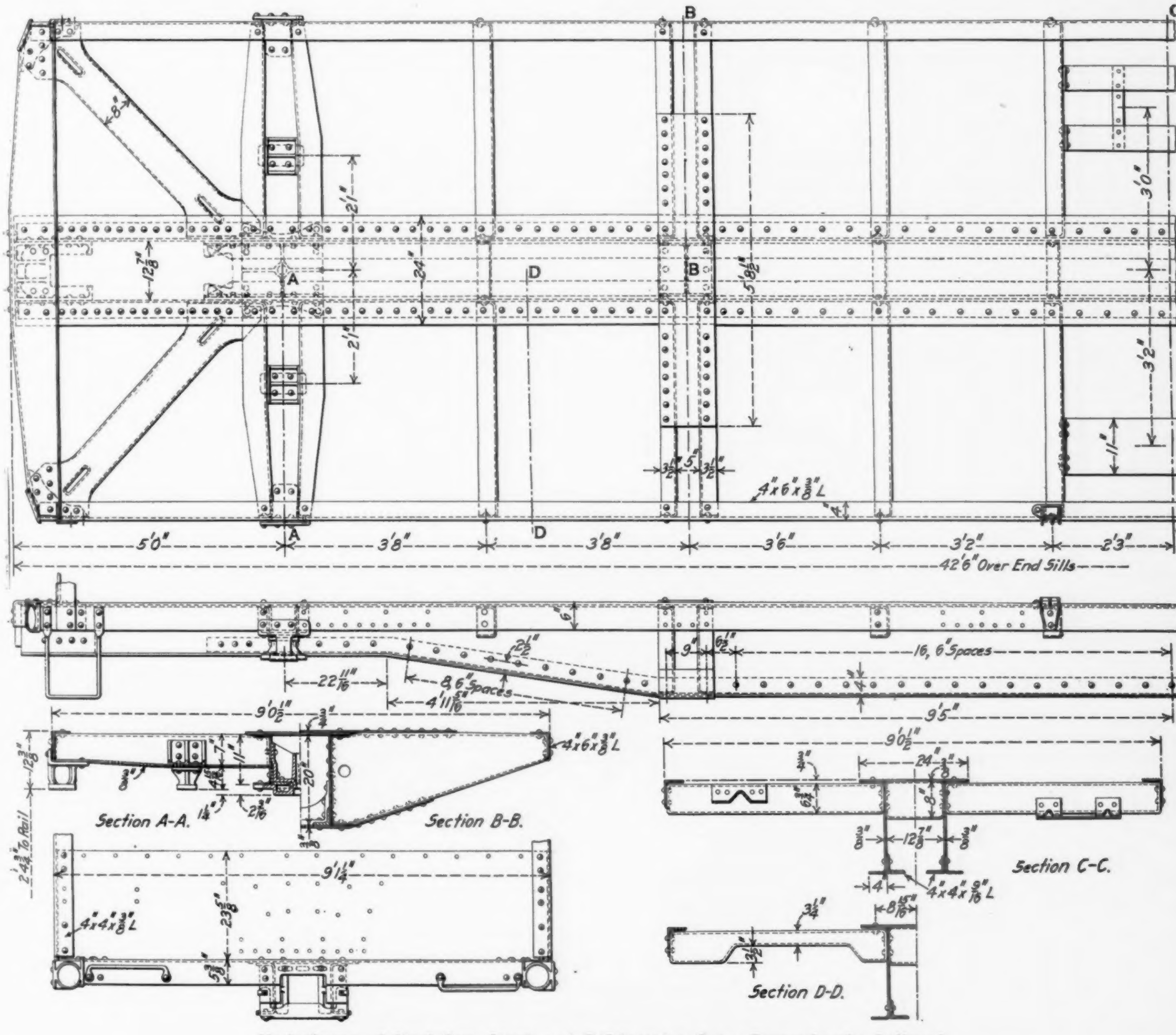
UNDERFRAME.

The underframe of these cars follows the same plan employed in the steel passenger cars on this road, wherein all of the weight of the car and lading is transferred to the center sills through the medium of two cantilevers, one at either end, located 7 ft. 4 in. inside the center plate, and the two end sills. Thus the body bolster, as it is customarily built, does not appear in this design and the framing at that point is only such as is needed for stiffness and to carry the side bearings. The center sills are formed of ⅜ in. plate pressed with 4 in. flanges at top and bottom. The sill is 20 in. deep between the cantilever connections and narrows to 11 in. at a point 22 11/16 in. inside the center plate and continues this section to the end sill. A 4 in. x 4 in. x 9/16 in. angle is riveted to the bottom of each sill on the inside, and extends continuously between the inside draft lug faces. which are incorporated in the center plate casting and are located about 15 in. outside the center pin at either end. A ⅜ in. x 24 in. top cover plate extends continuously for the full length of the center sills.

The cantilevers on either side of the center sill are formed of two dished sections of ⅜ in. plate, having 3½ in. flanges. These are set 5 in. apart and secured to the web of the center sill and to the 4 in. x 6 in. x ⅜ in. angle forming the bottom member of the side truss, hereafter called the side sill, by riveting through their flanges. There is a ⅜ in. x 12 in. top cover plate, 5 ft. 8½ in. in length and a similar ⅜ in. bottom cover plate which extend continuously across the top and bottom of the center sill and are riveted to the flanges of the cantilever members. A properly formed casting is used as a stiffener between the bottoms of the center sill girders at this point.

At the end sills a large part of the weight of the car structure is transferred by diagonal braces from the corners directly to the center sills; hence the structure of the underframe at this point is considerably lighter than at the cantilever, but is of even greater stiffness in the vertical plane. The end construction consists of a ⅜ in. plate extending the full width of the car. It has a depth of 5 in. below the top of the center sills and is flanged inward for a distance of 10⅜ in. at the center and narrows somewhat toward either side, and then is carried up on the inside of the corner and end posts for a distance of 23⅝ in. It is secured to the draft casting at the end, to a corner casting which includes the push pole pockets, to the side longitudinal angles, to the corner posts and the end post and braces, as well as to the two horizontal stiffeners between the corner post and the braces just at the top of this plate. A study of the drawings will show the advantages of this end construction, which not only has great stiffness in the vertical plane but also forms a secure and permanent end structure suitable for resisting shocks, both of shifting load and of misuse.

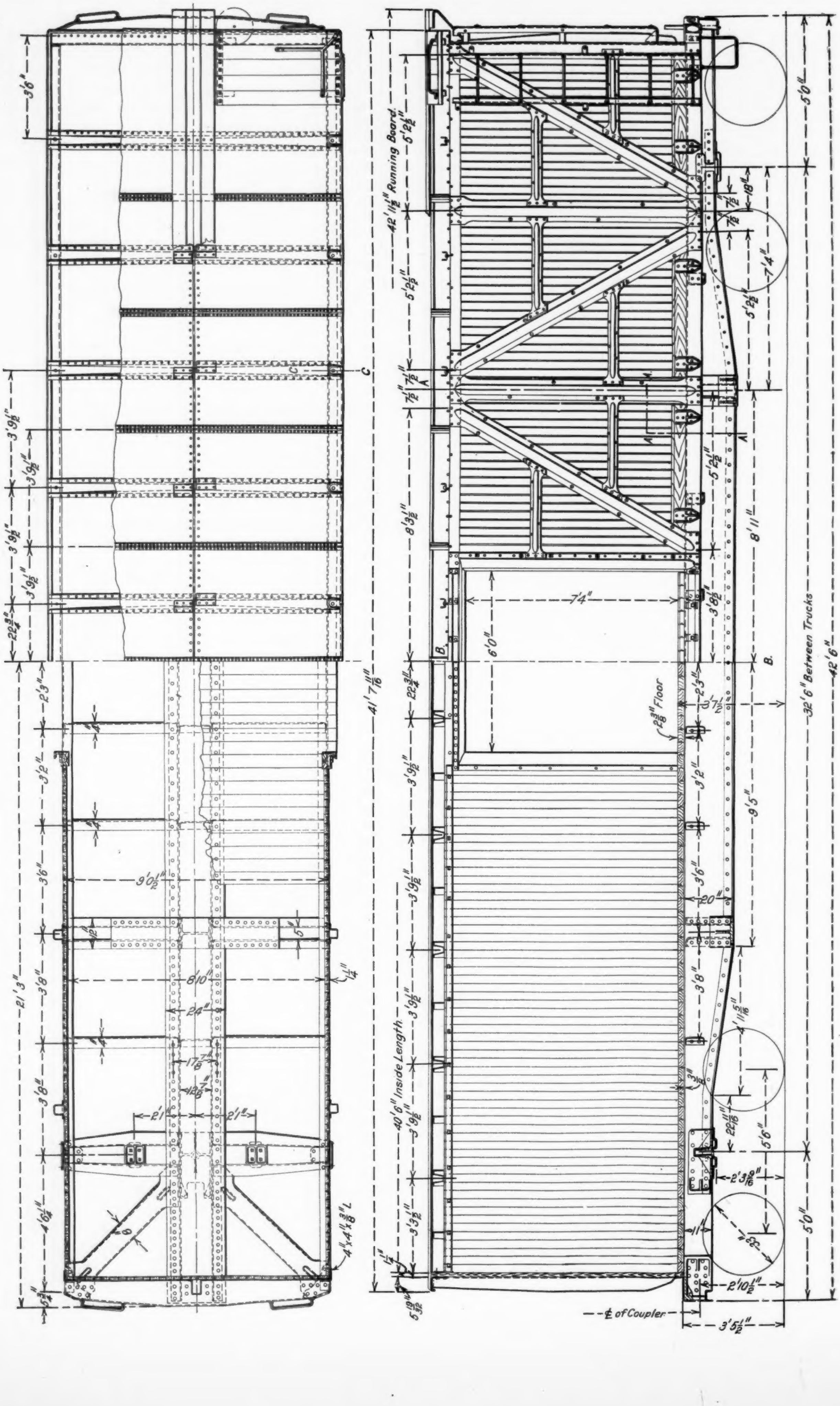
At the center plate the usual bolster is replaced by "U" shaped pressed steel sections 7 in. in depth, and 7⅜ in. wide in the channel section, which are riveted through their outward flanged edges to the center and side sills. Above the side bearing is an iron filling and stiffening piece. At the extreme end is a casting suitable for attaching chains, or for jacking the car. The



Underframe of Steel Box, Stock and Refrigerator Cars; Pennsylvania Railroad.

center plate casting fits between the members of the center sill and extends some distance toward the end sill, forming the back stop casting for the draft gear. The center plate itself is a separate piece riveted to the bottom of the sill. Very heavy diagonal braces extend from the corner casting, which includes the push pole pocket, to the center sills at the center plate.

There are six stiffeners between the center and side sills, four being located between the cantilevers and one midway between them and the center plate. These consist simply of dished sections 6¾ in. in depth and without cover plates. Similar dished pieces 8 in. in depth are secured between the center sills at these points. There are no intermediate longitudinal members, the

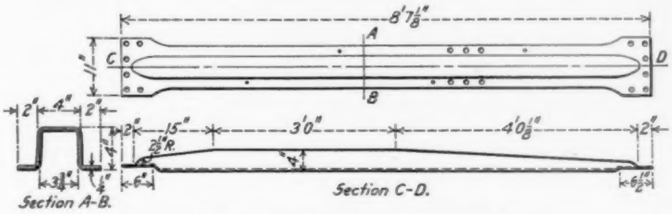


Forty-foot Box Car with Steel Frame and Steel Roof; Pennsylvania Railroad.

floor being constructed of 2⅜ in. material, giving ample strength to carry the lading without such supports.

SUPERSTRUCTURE.

The side framing consists of a series of posts and braces, each formed of ⅜ in. open hearth steel pressed in "U" shape of varying cross section, as is shown in the detail of one of the posts. The shape of these members is such as to give the greatest resistance to side thrust at a point about one-third of the distance above the floor. The side flanges are wide and the ends are flat, being riveted directly to the sill and plate. This type of post was selected on account of its great strength and light



Pressed Steel Posts for Steel Freight Cars.

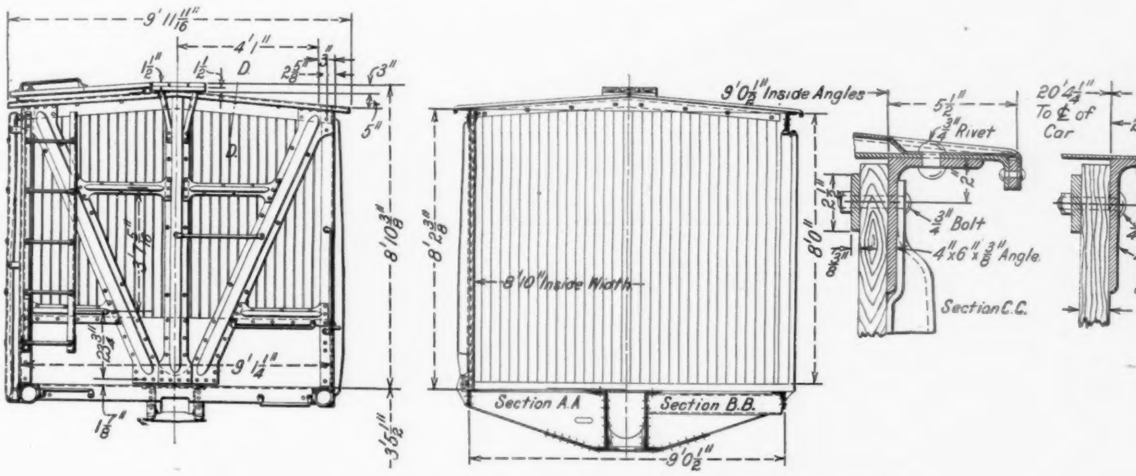
weight, and the opportunity given for a strong connection at the joint. Sufficient rivets can be inserted to develop the full strength of the member without the necessity of using angles or gusset plates. These posts and braces are secured at the top to a 4 in. x 6 in. x ⅜ in. angle which has its shorter leg extending outward. At the bottom, the angle forming the side sill has its shorter leg extending inward. The posts and braces are indented at the ends to fit around the angles, giving a smooth surface on the interior of the car for the attachment of the lining.

It will be noted that the main posts are located at the connection of the cantilever to the side sills and a large portion of the

themselves are bulb angles and are fastened to the plate and sill at either end.

The short horizontal struts of the same general style as the posts and braces, and secured between them at various points, are included as a means of fastening the side lining rather than part of the frame structure. The corner posts are 4 in. x 4 in. x ⅜ in. angles and have one leg cut away at the bottom where they are riveted to the side sills. Inasmuch as they pass outside of the end lining and are securely riveted to it, and are also fastened to the side sill, this does not offer a point of weakness. The end of the car has a post in the centre, and diagonal braces from the upper corners to the center sill on either side. These pass outside the steel end sheathing and are securely attached to it. They transfer practically all the weight of the car body and a portion of the lading directly to the end of the centre sills at this point. Practically all the rivets at the connections between the principal members in the side framing are ¾ in.

Specially designed steel carlines are spaced 3 ft. 9½ in. apart, being located without reference to the posts. These rest on top of the plate and are continued outside and flanged down at the ends. The ⅛ in. steel roof sheets are in sections of the same width as the distance between carlines, but the joint comes midway between the carlines. Above the butt joint between the sheets the upper cover plate is formed with a ridge in the centre which adds to the stiffness of the structure. One-quarter inch rivets are spaced close together at the joint and no calking is required. The roof sheets on the cars now under construction are not continuous across the car and the joint at the center is formed by flanging up the edges and riveting them together. At the eaves the roof sheets are carried out beyond the plate and flanged over and a ⅜ in. x 1 in. strip is riveted along the edge on the inside, forming a stiffening piece. The roof structure is secured to the car framing at the sides by only ten



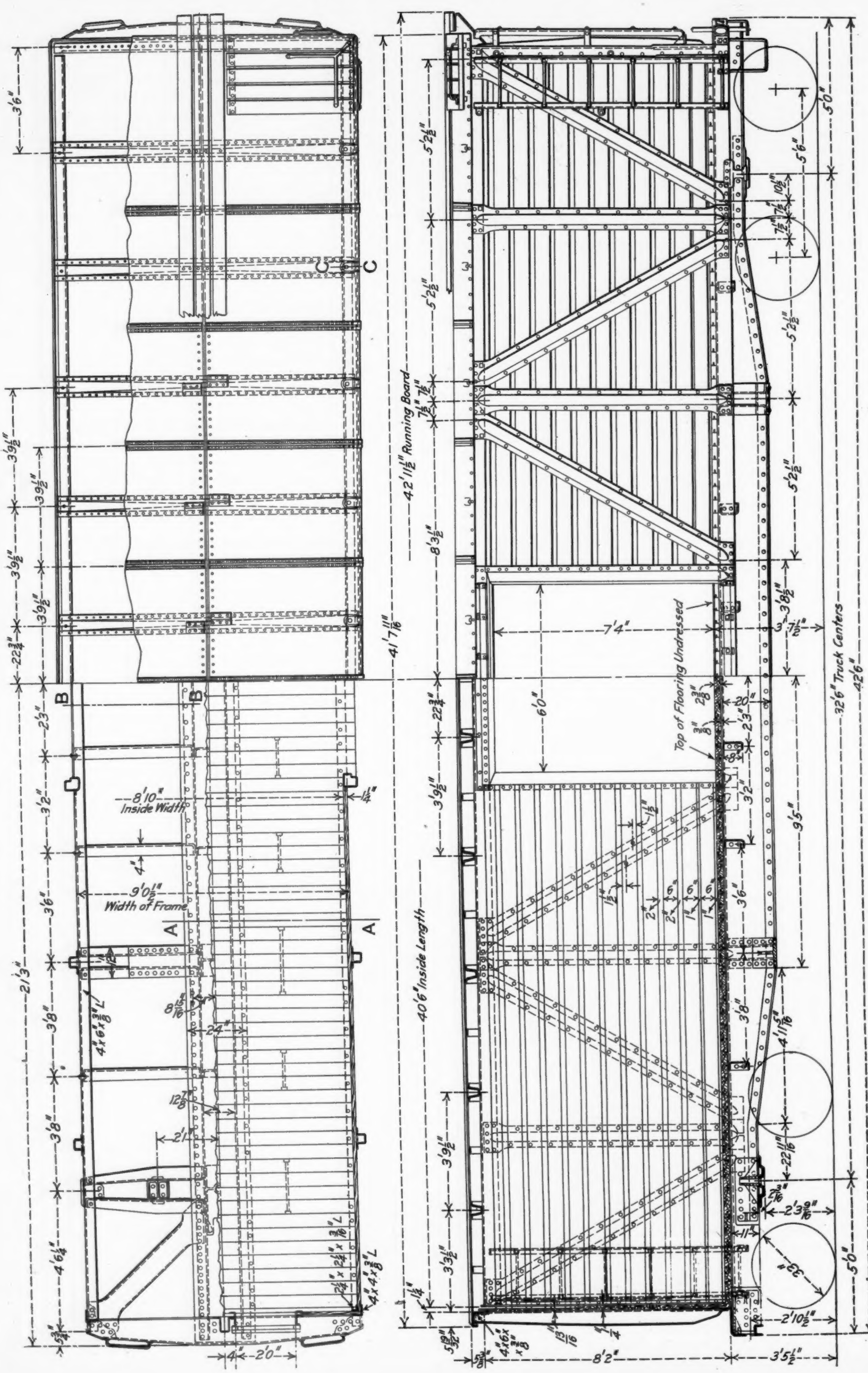
End Elevation and Sections of Steel Frame Box Car.

weight of the car body superstructure, as well as part of the lading, will be carried through these posts and the cantilevers to the center sills. The weight from either side is transferred to them at the top by the diagonal braces which are of the same general form and style. Another post is located between the main posts and the end of the car. It will be seen that this does not come opposite the center plate and none of the load is transferred to the underframe at this point. The weight of the roof carried by this member is transferred up through the diagonal braces and distributed equally to the main post and to the end framing. Both the upper and lower longitudinal members of the truss are continuous for the full length of the car body. The side sill is reinforced under the door by a 4 in. x 3½ in. x ⅜ in. bulb angle riveted to it. The Z bars installed for door slides also give some reinforcement at the top of the openings. The door posts

rivets on each side. These are at the carlines where the sheet is bumped down and a ¾ in. rivet passes through the sheet, carline and outwardly extending leg of the angle forming the plate. At the end of the car, the carline is formed of a 4 in. x 6 in. x ⅜ in. angle of the proper shape, and the roof sheets extend over it and are secured to it by a large number of ½ in. rivets. Here the eaves are carried over in the same manner as at the sides.

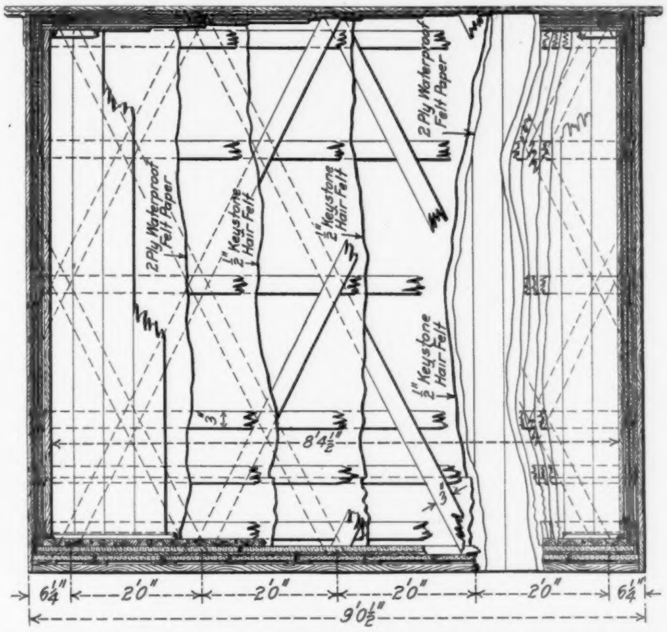
The running boards are fastened to two short sections of Z-bars, riveted directly to the carlines and through the roof sheets as is shown in the illustration.

The wooden side lining is secured on the inside of the frame at the top by means of a ⅜ in. x 2½ in. bar on the inside of the lining, which is held by ¾ in. bolts passing through the plate and with nuts on the inside. It will be noted that the top of the lining is somewhat below the top of the plate and that be-



Stock Car Which Practically Differs from the Box Car Only in the Lining and the Type of Door.

tween all carlines there is an open space between the plate and the roof sheet, equal to the thickness of the carlines at this point. This permits excellent ventilation of the car without the possibility of the entrance of snow or rain. At the bottom the side lining extends inside of the floor down to the side sill, and is held on the outside by a wooden strip fitted between the posts and braces, which is held by castings riveted to the side sills. In



Section of Refrigerator Car Showing Method of Applying Insulation.

addition, the lining is secured to the posts and braces by numerous screws. At the end of the car the lining only extends down to the top of the steel plate.

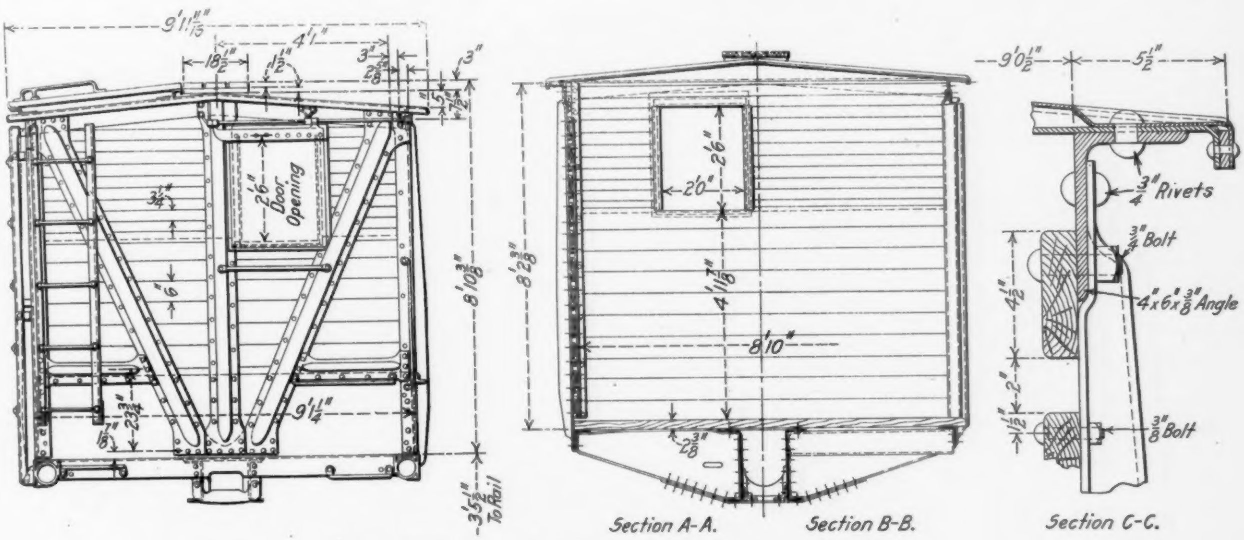
DOORS.

An all-steel door of exceptionally light and simple design has been applied on the box cars. It consists of a sheet of ⅛ in. steel of the proper size flanged over in box section at the bottom and in "U" section at the top. An upward extending flange at the box section is spot welded to the main sheet. There are two horizontal pressed steel members of "U" section equally spaced on the outside of the sheet and spot welded in place. At either side are Z-bars, spot welded in place. These are formed over in hook shape at the bottom and pass under and back of the edge of the bulb angle secured below the floor opening. This angle is continued to the first post. At the top the Z-bars are flattened out and secured in the flange at the uppcr part of the sheet. At this point are also riveted the carrying irons which are not provided with rollers but slide with metallic contact on the abbreviated Z-bar at the top of the door opening, which also extends to the first post.

The door is thus secured at each corner, both top and bottom, no matter what its position may be. It is entirely smooth on the inner surface and is set out sufficient to clear the side posts and braces. The floor is carried out to meet the door in the opening, the extension being supported by the bulb angle. The sides of the opening are filled by bulb angles of the proper width which are secured to the top and bottom members of the door frame by corner irons, and are also riveted to the sill and side plate. These members form the door posts and are backed up by 2 in. hard wood strips. The Z-bars at either side of the door are flanged from steel plates, and the one at the back of the door is carried around the edge of the sheet to form a lip and seal the opening. The door stop is another Z-bar flanged from plate and secured on the outside of the door post. It extends out a sufficient distance to form a stop for the full height of the door. The handle is riveted directly to the sheet and does not increase the side clearance of the car.

STOCK CAR

The adaptation of this framing to a stock car is shown in one of the illustrations. The only changes are in the method of securing the lining or slats, and the arrangement of the door. The underframe, side framing and roof structure are practically identical with the box car. Since the slats run horizontally there is no necessity for the horizontal struts between the posts and braces. The hard wood strips forming the slats are 1¼ in. x 6 in. and are secured directly to the framing by ⅜ in. bolts with the nuts on the outside. An end door is desired in this car, and it will be seen that there was sufficient room between the end post and the diagonal brace in the upper part of the car. This door is arranged to slide toward the side of the car. There is a small 2¼ in. x 2¼ in. x 3/16 in. angle on the inside of the corners to hold the end of the wooden slats. The doors on this car are of the flush sliding type that has been standard for this type of equipment on the Pennsylvania.



End Elevation and Sections of Steel Frame Stock Car.

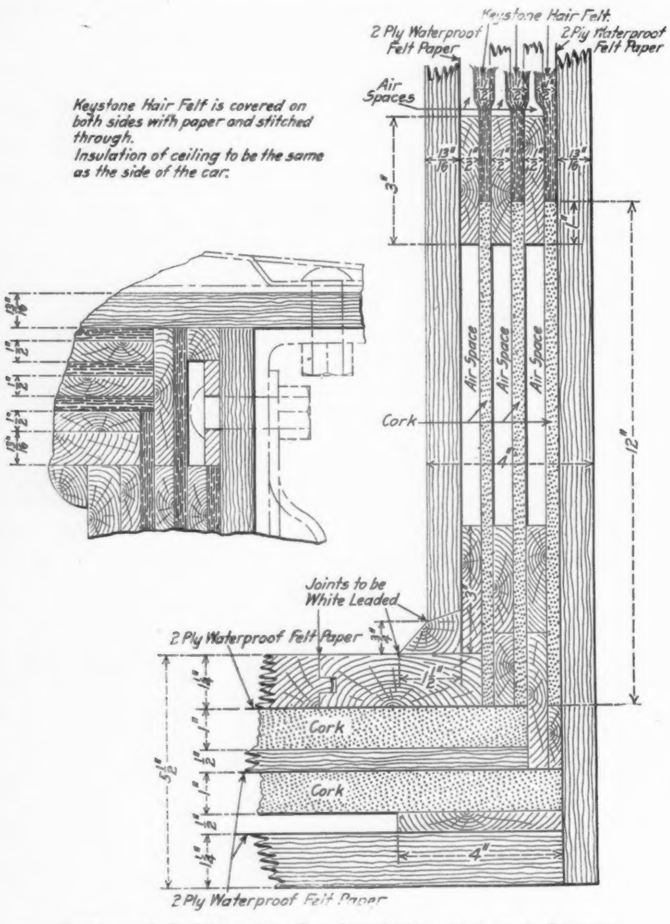
REFRIGERATOR CARS.

The framing of the refrigerator car does not differ from the box or stock car except at the door posts, where on account of the smaller door opening, the regular pressed steel post has been included and the doors are carried on separate wooden posts

bolted to the sills at the top and bottom and forming part of the lining. The type of insulation and the method of applying it is shown in one of the illustrations. It will be noted that the cork sheets are carried for nearly one foot above the floor level on the sides and ends, thus preventing the capillary attraction of the hair felt from carrying up any moisture that might possibly leak through at the floor level. The insulation at the floor is of cork and is laid in two 1 in. layers with a ½ in. between; there are also three layers of two-ply felt waterproof paper.

The door is of the type customarily used on refrigerator cars, and the Miner door operating fixtures have been applied. The joints around the door are sealed by heavy canvas and hair arranged as a cushion.

The car has an inside clear length between ice tanks of 32 ft.



Section of Refrigerator Car Insulation at Lower Corners.

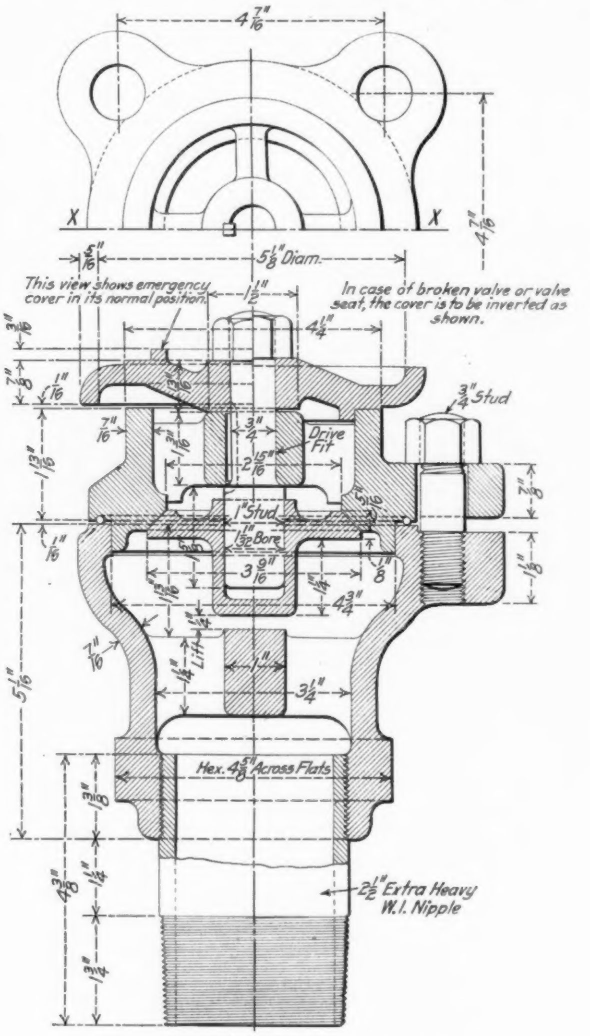
11½ in., a width of 8 ft. 4½ in. and a clear height of 7 ft. 4 13/16 in.

None of these cars have been completed, and it is impossible to obtain the actual weights; it is estimated that in each case the cars will weigh considerable less than the steel underframe and wooden superstructure car of the same size.

INTERESTING FRUIT EXHIBIT.—A number of employees of the Atchison, Topeka & Santa Fe shops at San Bernardino, Cal., were recently awarded a loving cup and a check for $100 as the first prize for the best exhibit at an orange show. Their exhibit consisted of a model of a locomotive and tender hauling a refrigerator car and caboose. The locomotive was complete even to the safety appliances and the refrigerator car and caboose were exact models of those used on the Santa Fe. The engine and tender were decorated with 700 dozen oranges and the whole train was elevated on a road bed decorated with 1,400 dozen lemons. The exhibit was prepared under the direction of H. S. Wall, superintendent of the San Bernardino shops.

VACUUM RELIEF VALVE

A steam chest relief valve designed to overcome some of the difficulties experienced with the types of valve now in service, has been designed in the office of the mechanical engineer of the Illinois Central. Reference to the illustration will quickly indicate two of its principal advantages, one being the cushioning of the valve when seating, and the other the use of a type of cap which can be reversed and used to seal the valve in an emergency. It will also be noted that the spindle is separate from the valve itself, and as it wears and the chamber in the valve becomes larger, it is only necessary to put in a new



Section X-X.

Vacuum Relief Valve Developed on the Illinois Central.

spindle of a larger size and not renew the whole valve. In addition to the cap forming an emergency seal when reversed, it also, in its normal position, tends to throw the steam downward and gives excellent protection against the entrance of cinders or dirt. The spindle is keyed in the upper part of the valve casing, but the valve itself is free to turn. A difference of 1/32 in. is allowed between the diameter of the spindle and the diameter of the chamber in the valve, or sufficient to permit a quick closing, but small enough to make the enclosed air act as a cushion and prevent the slamming of the valve against its seat, which is so frequently the cause of leaks, and often of broken valves.

FREIGHT TRAFFIC.—The number of tons of freight carried during the year ended June 30, 1911, was 1,781,637,954, which is a decrease of 68,262,147 over that of the previous year.

An Analysis of Wood Working Machines

Tools Required in a Car Repair Shop for General Repairs to 70 Passenger and 714 Freight Cars Per Month.

BY L. R. POMEROY.*

In laying out a new wood working shop for car repairs, it is desirable to have accurate information as to the amount of work that will be required of each machine for a certain definite output, as well as the length of time the machine will require to perform the operations.

So far as the writer knows there is no data available that will answer satisfactorily for this purpose and, therefore, in preparing for the design of a new shop of this character, a study of a large shop now in operation was made. The information thus collected was tabulated and permits a ready determination of the number and kind of wood working tools that would be required for any output desired. By segregating the repairs under various headings and into unit operations, which can be easily done either by an arbitrary selection based on a knowledge of the subject or by records available at any shop operating under similar conditions, it will be seen that the data given in the following tables give accurate information on the size and kind of tools that will be required, as well as the number of each type. If tools of greater or less capacity than those shown in the table are desired, the data here given can be easily prorated to give correct results.

The shop selected for the study was the Fitchburg shop of the Boston & Maine, which is working under a complete piece work system and at an efficiency probably as good as the average railway shop of its size in the country. This shop furnishes material for repairs made at the same point, as well as considerable material which is shipped to outside points.

In preparing the tables the method employed in arriving at the machine tool time was on the basis of the actual piece work prices and the number of pieces and operations. The latter were taken at the average of going conditions and schedules, covering six months' operation, checked by a careful analysis of three years' output. The time was then determined in the following manner:

Average time = Piece work price x Number pieces per month ÷ Average hourly rate.

In many cases the piece work price in the schedule covered the complete operation, which comprehended many tool operations. In such cases the price was segregated into the component machine movements participating in and forming a part of the completed portion, aggregate, or lump sum rate, on a percentage basis, the proper percentage being determined by observation and time study tests.

Table Number 1 represents material operations where the repairs were made and the material applied directly at the shop, in the nature of heavy repairs. It will be seen that the different tools and number of each kind are at the head of the columns,

TABLE III—TIME CHARGED MACHINES FOR CHANGING, ADJUSTING, SHARPENING, ETC.

	Times per Mo.	Shaper.	Sash Tenoner.	Sash Mortiser.	Gainer and Tenoner.	Saws.	Dowel Machine.	4-Side Planer.	Matcher.	Inside Moulder.	Rotary Bed Planer.	Single Surfacer.	Buzz Planer.
For chamfer, bead and round	150	25.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For sash	20	13.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For tongue and groove	5	1.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For O. G. ¼ and ½ round	100	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For square work, small head	50	5.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For square work, large head	100	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
For crown moulding	20	13.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set tenoner for sash and sharpen	25	.....	20.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set tenoner plane	50	.....	13.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set for gaining	25	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Set gainer plane	25	.....	.....	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....
Set gainer with form	20	.....	.....	.....	6.65	.....	.....	.....	.....	.....	.....	.....	.....
Set for grooving	100	.....	.....	.....	.....	16.65	.....	.....	.....	.....	.....	.....	.....
Set for marquetry	10	.....	.....	.....	.....	6.65	.....	.....	.....	.....	.....	.....	.....
Set when rolls changed	5	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....	.....	.....
Set when rolls not changed	15	.....	.....	.....	.....	.....	5.00	.....	.....	.....	.....	.....	.....
Removing knives and sharpening	35	.....	.....	.....	.....	.....	5.83	.....	.....	.....	.....	.....	.....
Set for square edge from dimensions	100	.....	.....	.....	.....	.....	.....	16.65	.....	.....	.....	.....	.....
From T. and G. to dimension	20	.....	.....	.....	.....	.....	.....	10.	.....	.....	.....	.....	.....
Set for Murphy roof strips	1	.....	.....	.....	.....	.....	.....	.....	2.50	.....	.....	.....	.....
Set for ash corners	2	.....	.....	.....	.....	.....	.....	.....	.....	2.31	.....	.....	.....
Set and sharpen	25	.....	.....	4.15	.....	.....	.....	.....	.....	.....	.....	.....	.....
Change knives and spurs, large G	2	.....	.....	.....	2.31	.....	.....	.....	.....	.....	.....	.....	.....
Change knives and spurs, sill G	2	.....	.....	.....	2.31	.....	.....	.....	.....	.....	.....	.....	.....
Changing knives (3)	5	2.5*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changing knives (3)	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.50	.....	.....
Changing knives (2)	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.50	.....
Changing knives	16	.....	.....	.....	.....	.....	.....	.....	2.66	.....	.....	.....	.....
Change and sharpen sidehead	2	.....	.....	.....	.....	.....	.....	.....	1.00	.....	.....	.....	.....
Change and sharpen sidehead	3	.....	.....	.....	.....	.....	.....	.....	.....	2.00	.....	.....	.....
Change knives (2)	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.83
Set knives for fluted roofing	6	.....	.....	.....	.....	.....	.....	.....	0.40	.....	.....	.....	.....
Set for window belt strips	10	.....	.....	.....	.....	.....	.....	.....	.....	8.32	.....	.....	.....
Set for sideheads	3	.....	.....	.....	.....	.....	.....	1.86	.....	.....	.....	.....	.....
Set top and bottom cylinders	8	.....	.....	.....	.....	.....	.....	5.83	.....	.....	.....	.....	.....
Sharpen with file and stone, sideheads	8	.....	.....	.....	.....	.....	.....	2.13	.....	.....	.....	.....	.....
Sharpen with file and stone, top cylinder	8	.....	.....	.....	.....	.....	.....	2.64	.....	.....	.....	.....	.....
Sharpen with file and stone, bottom cylinder	8	.....	.....	.....	.....	.....	.....	2.64	.....	.....	.....	.....	.....
Total	....	90.99	38.25	4.15	15.42	23.30	13.33	25.10	6.56	12.63	2.50	2.50	5.83
Sharpen and set for T. & G. dimensioner	....	.....	.....	.....	.....	.....	.....	16.65	.....	.....	.....	.....	.....
Sharpen and set for G. & W. planer	....	2.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

* G. & W. planer.

*Consulting Engineer, 105 West 40th Street, New York City.

TABLE I—DETAILED DISTRIBUTION OF WORK ON A TIME BASIS.

ITEM AND QUANTITY.	18" Rip Saw.	24" Rip Saw.	22" Rip Saw.	Self-feed Rip Saw.	Combination Rip and C. O. Saw.	Edging Saw.	Swng. C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Tenoner and Gainer.	Shaper.	Outside Moulder.	Inside Moulder.	Gray & Wood Planer.	3-Spindle Vertical Borer.	1-Spindle Horizontal Borer.	Vertical H. C. Mortiser.	Horizontal H. C. Mortiser.	Rotary Bed Planer.	Single Surfacer.	Sash Tenoner.	Panel Machine.	Sash Mortiser.	Berlin 4-Side Timber Planer.
Number of tools	2	1	1		1	2	2	2	3	2	4	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Arms, canopy passenger 25	....	....	1.33	....	1.98	....	0.64	....	2.63	1.18	....	2.00	....	....	....	....	....	....	....	....	1.00	....	....	....	....
Arms, canopy, caboose 12	....	....	1.04	....	1.03	....	0.40	....	....	0.40	0.60	....	....	....	....	....	....	....	....	....	0.44	....	....	....	....
Canopy arch finish 30	....	....	1.00	....	....	....	1.00	....	....	1.00	....	2.50	....	....	....	....	....	....	....	....	1.08	....	....	....	....
Bars, pulp cars 10	....	....	....	....	....	....	0.17	....	....	....	....	....	....	....	0.33	0.21	....	....	....	....	....	....	....	....	....
Battens ....15 sets and 575 pcs.	....	....	12.31	....	....	....	5.59	....	0.62	8.10	....	1.50	9.59	....	....	....	....	....	....	....	9.40	....	....	....	....
Belt rail ....600′	....	....	2.00	....	....	....	....	....	....	4.00	....	....	4.00	....	....	....	....	....	....	....	2.90	....	....	....	....
Beads—																									
Sash ....2,500′ Door ....600′ Screens ....2,500′	....	....	6.24	....	6.24	....	....	....	....	1.03	....	....	9.33	....	....	....	....	....	....	....	7.60	....	....	....	....
W. box (pcs.) 170	....	....	....	....	1.31	....	0.78	....	....	1.56	....	1.20	....	....	....	....	2.60	....	....	....	1.86	....	....	....	....
Brake beams 10	....	....	0.25	....	....	....	....	0.17	....	....	....	....	....	....	0.33	0.47	....	....	....	....	....	....	....	....	....
Boxes, emergency 24	....	....	4.92	....	6.45	....	1.53	....	....	1.02	....	1.38	....	....	....	....	....	....	....	....	0.67	....	....	....	....
Boxes, equipment, etc. 108	....	....	6.13	....	8.15	....	5.45	....	....	7.11	3.54	3.10	....	....	....	0.52	....	....	....	....	3.30	....	....	....	....
Blocks, various 2,716	....	....	59.86	....	....	....	....	20.71	1.35	0.35	....	....	....	....	....	6.00	0.10	....	....	58.56	4.20	....	....	....	....
Boards—																									
Roof ....7½ M′ Lining ....35 M′ Floor ....15 M′ Running ....10 M′ Letter ....500′ Finish ....50 M′ Miscellaneous ....110′	....	....	....	28.30	....	0.54	57.63	....	....	5.70	....	5.20	....	0.17	....	....	....	1.82	....	....	4.70	....	....	....	34.20
Body bolsters 65	....	....	....	....	....	....	....	3.34	....	....	7.00	....	....	....	7.07	12.65	....	8.75	....	....	....	....	....	....	....
Bracing, passenger and baggage 65	....	....	....	1.23	....	....	1.33	....	....	0.84	....	....	....	....	....	0.07	....	....	....	....	....	....	....	....	0.78
Bracing, caboose and freight 50	....	....	....	0.83	....	....	1.66	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1.20
Bumper beams 285	....	9.00	....	....	....	....	....	8.50	....	....	....	....	....	....	....	12.60	....	1.22	....	....	12.00	....	....	....	....
Bars, horse cars 27	....	0.70	....	....	....	0.28	0.45	....	....	....	....	0.13	....	....	....	....	....	....	....	0.20	0.02	....	....	....	....
Bridging sill 200	....	2.00	....	....	....	....	3.33	....	....	....	6.67	....	....	....	....	....	....	....	....	2.00	....	....	....	....	....
Carlines 178	....	....	....	....	....	....	6.64	....	12.46	3.57	8.18	6.82	....	....	1.67	0.09	2.79	0.21	....	....	6.90	....	....	....	....
Cases, drawers, etc., mail car 28	....	....	4.44	....	21.71	....	....	....	0.15	5.62	....	2.93	....	....	....	....	1.66	....	....	....	4.20	4.03	....	4.48	....
Closets, baggage and caboose car 5	....	....	0.16	....	0.97	....	6.49	....	....	0.39	....	0.25	....	....	....	....	....	....	....	....	0.09	0.12	....	0.12	....
Casing edg., pass. and caboose 55	....	....	1.90	....	2.89	....	1.00	....	....	1.43	....	1.84	....	....	....	....	1.83	....	....	....	1.85	....	....	....	....
Cleats 15	....	....	0.10	....	0.12	....	0.01	....	....	0.13	....	....	....	....	....	....	....	....	....	....	0.12	....	....	....	....
Door frames, sash, battens, rails 140	....	....	17.80	....	24.64	....	10.65	....	....	22.92	....	7.54	1.00	....	....	1.52	0.03	....	....	1.08	16.00	23.67	....	24.55	0.96
Desks, drawers, caboose 13	....	....	1.17	....	4.71	....	0.82	....	....	2.40	....	0.25	....	....	....	....	....	....	....	....	1.39	0.75	....	0.75	....
Dowels (dowel mch. 6.23) 1,500	....	....	3.12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2.26	....	....	....	....
Finish, P. M. B. & H.	....	....	2.32	....	....	1.55	2.26	....	1.60	1.82	....	1.43	....	1.86	....	....	....	....	....	....	3.00	....	....	....	....
Frames, door 20	....	....	2.40	....	2.39	....	2.15	....	0.53	3.15	3.37	0.86	....	0.03	....	....	1.33	....	....	1.00	0.70	....	....	2.94	....
Filling ....2,800′	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7.47	....	....	....	....	....
Furring 75	....	....	0.80	....	....	....	0.53	....	2.77	....	....	....	....	....	....	....	....	....	....	1.40	....	....	....	....	....
Guards, dust 250	....	....	1.06	....	1.75	....	0.68	....	....	1.66	....	....	....	....	....	....	0.41	....	....	....	0.91	....	....	....	....
Gates, horse cars 2	....	....	1.08	....	2.59	....	1.50	....	1.13	1.50	0.67	1.83	....	....	....	....	0.84	....	....	....	1.57	....	....	....	0.46
Girths—																									
Freight ....75 Platform ....25 Trans. 20	1.01	....	....	....	....	....	....	0.87	2.76	0.40	2.01	....	....	....	....	....	....	0.58	0.44	....	....	....	....	....	....
Hopper, cov. lids, etc. 4	....	....	4.18	....	....	....	....	1.62	....	0.96	....	0.87	....	....	....	....	0.25	....	....	....	0.89	....	....	....	....
Headers, baggage door 4	....	....	2.87	....	....	....	....	1.73	1.13	1.05	....	....	....	....	....	....	1.43	....	....	....	0.52	....	....	2.02	....
Ladders 300	....	....	2.50	....	....	....	....	5.00	....	....	....	....	....	....	....	19.00	....	....	....	7.50	....	....	....	....	....
Lintels 360	....	....	0.61	....	1.04	....	0.43	....	....	0.94	....	0.77	....	....	....	....	1.01	....	....	....	0.56	....	....	....	....
Moulding ....7,120′	....	....	7.48	....	....	4.10	....	....	....	3.21	....	3.20	4.80	8.47	....	....	....	....	....	....	3.00	....	....	....	....
Moulding, pcs. 210	....	....	0.15	....	....	....	4.84	....	4.63	3.89	....	9.65	....	....	....	....	....	....	....	....	2.90	....	....	....	....
Moulding, from stock ....3,500′	....	....	8.00	....	8.00	7.00	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11.70	....	....	....	....
Panels, monitor and sides ....435 Panels, canopy 15	....	....	3.86	....	10.35	....	6.51	....	....	5.52	....	0.15	....	....	....	....	0.13	....	....	....	5.10	....	....	....	....
Partitions 3	....	....	2.80	....	11.13	....	5.83	....	3.95	3.90	....	6.08	....	....	....	....	1.33	....	....	....	4.60	3.24	....	1.82	....
Pilasters 40	....	....	1.85	....	2.35	....	0.49	....	....	0.66	0.04	0.17	....	....	....	....	0.08	....	....	....	0.40	....	....	....	....
Plates—																									
Freight ....110 Passenger ....10 Caboose ....4 Splice 107	....	....	0.17	....	....	....	....	5.61	12.92	0.37	22.40	0.17	....	....	13.80	18.80	....	29.00	....	....	0.30	....	....	....	6.30
Posts—																									
Passenger, C. and D. ....50 Caboose ....2 Freight, C. & D. ....455 Purlines 25	....	....	39.49	....	....	....	9.74	....	1.88	1.41	13.12	....	....	1.85	0.27	9.10	....	0.61	2.49	26.17	2.44	3.13	....	....	1.50

TABLE I (CONTINUED).

ITEM AND QUANTITY.	18" Rip Saw.	24" Rip Saw.	22" Rip Saw.	Self-feed Rip Saw.	Combination Rip and C. O. Saw.	Edging Saw.	Swng. C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Tenoner and Gainer.	Shaper.	Outside Moulder.	Inside Moulder.	Gray & Wood Planer.	3-Spindle Vertical Borer.	1-Spindle Horizontal Borer.	Vertical H. C. Mortiser.	Horizontal H. C. Mortiser.	Rotary Bed Planer.	Single Surfacer.	Sash Tenoner.	Panel Machine.	Sash Mortiser.	Berlin 4-Side Timber Planer.
Number of tools..........	2	1	1		1	2	2	2	3	2	4	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Platform arms 75	.....	.....	.....	.....	.....	.....	.....	.....	6.25	.....	.....	.....	.....	10.00	10.00	3.90	.....	.....	.....	.....	.....	.....	.....	.....	1.50
Platform truss beam...........15																									
Platform T. B. blocks.........15																									
Platform furring blocks........30																									
Platform B. S. blocks.........15	.....	.....	.....	.....	.....	.....	.....	2.56	1.00	5.60	2.56	6.50	.....	.....	.....	3.86	.....	2.00	.....	.....	5.25	.....	.....	.....	2.00
Platform cross blocks..........15																									
Platform C. I. blocks..........15																									
Platform cover blocks.........60																									
Planks ....25,000'	.....	.....	.....	.....	.....	.....	3.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18.85
Planks, floor, side, splices......425	.....	.....	.....	3.00	.....	.....	11.83	.....	1.50	.....	.....	.....	.....	.....	.....	6.60	.....	.....	.....	5.00	.....	.....	.....	.....	.....
Rafters 41	.....	.....	.....	1.16	.....	.....	1.66	.....	3.51	1.36	.....	0.32	.....	.....	.....	.....	.....	.....	.....	.....	2.26	.....	.....	.....	.....
Refrigerator sinks, caboose........2	.....	.....	0.42	.....	1.62	.....	0.71	.....	.....	0.99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.61	1.00	.....	0.75	.....
Racks, milk cars................24	.....	.....	1.20	.....	.....	3.60	1.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.40	.....	.....	.....	.....
Sash—																									
Sides, ends 45																									
Monitor 200	.....	.....	4.35	.....	5.51	.....	14.22	.....	.....	6.75	0.17	10.76	5.22	.....	.....	.....	1.00	.....	.....	.....	6.40	12.18	.....	14.32	.....
Caboose 25																									
Sheathing, P. B. M.........35,800'	.....	.....	31.70	.....	.....	23.33	17.66	.....	.....	.....	.....	.....	.....	46.66	.....	.....	.....	.....	.....	.....	19.20	.....	.....	.....	.....
Shields, door, baggage car stove...8	.....	.....	1.13	.....	1.70	.....	0.58	.....	.....	0.60	.....	0.60	.....	.....	.....	.....	0.50	.....	.....	.....	0.93	2.64	.....	1.30	.....
Shelving, baggage car...........12	.....	.....	0.68	.....	1.39	.....	0.71	.....	.....	0.94	.....	0.30	.....	.....	.....	.....	.....	.....	.....	.....	0.96	.....	.....	.....	.....
Sills—																									
Side 324																									
End 373																									
Interior 12																									
Draft 35	.....	.....	.....	8.06	.....	.....	.....	73.26	.....	8.06	109.27	.....	.....	.....	61.65	200.00	.....	131.00	.....	.....	.....	.....	.....	.....	63.50
Splices 410																									
Sub 20																									
Buffer 99																									
Stakes 160	.....	.....	.....	3.00	.....	.....	.....	2.67	.....	.....	.....	.....	.....	.....	.....	3.45	.....	.....	.....	5.18	.....	.....	.....	.....	.....
Step—																									
Treads 350																									
Risers 50	.....	.....	3,36	.....	7.56	.....	5.10	.....	1.91	9.91	.....	2.92	.....	.....	.....	3.45	4.62	.....	.....	0.75	5.00	.....	4.13	.....	.....
Sides 33																									
Brake 90																									
Stools, window 220	.....	.....	0.71	.....	0.71	.....	0.25	.....	.....	0.93	.....	0.11	.....	1.33	.....	.....	0.08	.....	.....	.....	0.61	0.17	.....	.....	.....
Stops: door, 100; dft. timbr.,150.250	.....	.....	1.75	.....	0.58	.....	2.58	.....	1.25	0.34	.....	0.66	.....	.....	.....	6.50	.....	.....	.....	4.10	0.38	.....	.....	.....	.....
Studding—																									
Passenger B. H. C..........70																									
Monitor 40	.....	.....	.....	12.80	.....	.....	5.83	.....	.....	2.35	23.16	.....	.....	.....	.....	0.11	.....	.....	.....	.....	.....	0.67	.....	.....	11.90
Caboose 50																									
Freight car 500																									
Spacing strips, roof...........2,800	.....	.....	2.33	.....	2.33	.....	1.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.80
Seat frames 32	.....	.....	1.20	.....	1.20	.....	0.80	.....	1.60	1.60	2.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.80	2.40	.....	2.40	.....
Saddles, thresh.......200', 664 pcs.	.....	.....	2.39	.....	2.39	.....	161.59	.....	128.25	3.79	1.19	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.92	1.19	.....	1.19	.....
Seat ends, mahogany............10	.....	.....	0.68	.....	1.05	.....	0.37	.....	.....	1.34	.....	0.94	.....	.....	.....	.....	2.00	.....	.....	.....	1.00	.....	.....	.....	.....
Sheathing, roof, floor...........780	.....	.....	13.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.10	.....	.....	.....	1.50
Roof pole space, strips.........215	.....	.....	.....	1.71	.....	.....	1.57	.....	0.96	1.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ties 80	.....	.....	.....	.....	.....	.....	.....	2.65	.....	.....	10.03	.....	.....	.....	5.30	10.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
Timbers, dft., stop...620', 1,060 pcs.	.....	.....	1.33	.....	.....	.....	.....	14.61	23.03	.....	68.05	.....	.....	.....	55.60	62.00	.....	1.20	44.01	11.30	.....	.....	.....	.....	.....
Truck—																									
Wh. pce. 14																									
Transom 52																									
S. beam 36																									
Bolster 4																									
Sp. plank 4	.....	.....	1.08	.....	.....	.....	.....	10.40	4.06	.....	18.65	.....	.....	.....	19.75	43.60	.....	11.60	.....	0.26	.....	.....	.....	.....	1.53
C. pin block 4																									
End sill 14																									
Freight bolster 47																									
Freight transom 10																									
Freight sp. plank............7																									
Shelving, milk cars..............45	.....	.....	7.27	.....	.....	.....	2.07	.....	.....	3.12	.....	.....	.....	.....	.....	.....	3.10	.....	.....	5.16	.....	.....	.....	.....	.....
Total	1.01	11.70	279.97	60.09	145.84	40.40	373.98	153.70	223.83	148.07	303.08	84.93	33.94	60.37	175.77	424.50	27.12	187.99	46.94	137.13	174.39	55.19	4.13	56.64	151.98

while the articles or pieces shaped and machined are in the first column. The time required for each tool operation, determined on the basis described, is then given in the columns under each tool heading. It will be seen that while in some operations work on but one tool is required, there are others that required as high as seven different tools for completion.

TABLE I (Continued).

ADDITIONAL ITEMS.	Jig Saw.	Dowel Machine.	Lathe.	Daniels Planer.	Resaw.	Matcher.
Arch finish	3.00	.....	.....	.....	.....	.....
Dust guards	1.25	.....	0.75	.....	.....	.....
Hopper cov.	0.58	.....	.....	.....	.....	.....
Sash, blocks, etc.	2.33	.....	0.18	.....	.....	.....
Boards	.....	.....	.....	.....	.....	54.17
Dowels	.....	6.23	.....	.....	.....	.....
Drawers, etc.	.....	.....	.....	2.40	.....	.....
Resawing	.....	.....	.....	.....	11.83	.....
Total	7.16	6.23	0.93	2.40	11.83	54.17

Table Number 2 gives the same information in connection with material that is furnished to outside repair points, covering light or running repairs such as are made in terminal or junction yards. In connection with this table it might be mentioned, that, while the number of cars in the total that are credited to the shop for this outside operation are based on general repairs determined by an average time per car, obtained from the shop operation for the heavy home repairs, as a matter of fact this material for outside repair or inspection points represented light repairs on 430 cars, while the equivalent number of cars equated on a heavy repair basis represents 80 cars.

Table Number 3 gives the detail time for sharpening, changing and adjusting knives and rolls on the various tools, this being a

TABLE II—CAR MATERIAL FURNISHED OUTSIDE POINTS.

ITEM AND QUANTITY.	Rip Saw, 18", 22", 24".	Self-feed Rip Saw.	Comb'n Rip and C. O. Saw.	Edging Saw.	S'w C. O. Saw.	R'y C. O. Saw.	Band Saw.	Buzz Planer.	Single Surfacer.	Shaper.	3-S. V. Borer.	1-S. H. Borer.	Rotary Bed Planer.	4-S. Timber Planer.	Matcher.	Lathe.	Tongue and Groove.	Inside Moulder.	G. & W. Planer.	Jig Saw.	Vert. H. C. Mortiser.	Panel Machine.
Battens, standard...250	6.25	.....	2.98	.....	.....	.....	.....	2.08	3.50	4.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Beads, glass......1,200	3.60	.....	0.17	0.40	.....	.....	.....	.....	3.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brake beams 10	.....	.....	.....	.....	.....	.....	0.50	.....	.....	.....	.....	0.50	4.17	.....	.....	.....	.....	.....	.....	.....	.....	.....
Blocks, truss.......250	2.08	.....	.....	.....	.....	2.09	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boards— Lining ....3,500'; Finish ....4,000'; Running .....15,000'; Floor ....2,500'; Pratt door.......50'	.....	5.67	.....	.....	11.66	.....	.....	.....	.....	.....	.....	.....	3.33	2.90	13.33	.....	.....	.....	.....	.....	.....	.....
Bolsters 290	6.83	.....	.....	.....	.....	7.99	.....	.....	.....	.....	8.33	.....	.....	.....	.....	.....	.....	.....	23.00	.....	.....	.....
Dust guards 200	0.67	.....	0.66	.....	0.50	.....	.....	1.33	0.84	.....	.....	0.33	.....	.....	.....	0.50	.....	.....	.....	1.00	.....	.....
Ladder sides 250	2.08	.....	.....	.....	.....	0.50	.....	.....	.....	.....	.....	4.28	6.25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Plates and planks..275	2.50	.....	.....	.....	.....	7.92	.....	.....	.....	.....	1.58	.....	2.50	3.00	.....	.....	.....	.....	3.71	.....	.....	.....
Sills, various 500	.....	.....	.....	2.50	.....	11.64	2.50	1.66	.....	.....	18.80	.....	.....	6.50	.....	.....	5.00	.....	24.16	.....	13.20	.....
Sheathing, pass..5,000'	6.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.00	.....	.....	.....	.....	8.30	.....	.....	.....	.....
1,600'	.....	.....	.....	3.73	3.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Stakes 250	.....	.....	.....	.....	.....	4.16	1.66	.....	.....	.....	0.53	.....	16.66	.....	.....	.....	.....	.....	.....	.....	.....	.....
Step treads 250	3.42	.....	1.91	0.42	.....	.....	.....	2.33	1.82	2.07	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Step brake..........30; Step pass. side......25	.....	.....	.....	.....	.....	.....	1.25	0.83	0.70	1.86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.33
Stops, frt. car door.150	1.25	.....	1.25	.....	.....	.....	0.41	.....	.....	.....	1.05	.....	3.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
Studding, frt. car..100	.....	.....	.....	.....	0.49	.....	6.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Saddles, frt. & cab. c.675	.....	.....	.....	.....	1.70	.....	6.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tie & dft. timbers..150	.....	.....	.....	.....	.....	12.50	1.25	.....	.....	.....	3.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.10	.....
Truck sills 20	.....	.....	.....	.....	.....	1.27	0.83	.....	.....	.....	3.35	.....	.....	.....	.....	.....	.....	.....	2.66	.....	3.70	.....
Total	35.38	5.67	6.97	7.05	18.02	48.07	21.21	8.23	10.26	8.10	37.29	9.28	40.91	12.40	13.33	0.50	5.00	8.30	53.53	1.00	21.00	3.33

TABLE IV—MATERIAL OTHER THAN CAR REPAIRS.

ITEM AND QUANTITY.	18", 22", 24" Rip Saw.	Self-feed Rip Saw.	Comb. Rip and C. O. Saw.	Edging Saw.	Sw. C. O. Saw.	Ry. C. O. Saw.	Band Saw.	Buzz Planer.	Single Surfacer.	Shaper.	1-S. H. Borer.	Rotary Bed Planer.	Dowel Machine.	Lathe.	G. & W. Planer.	Gainer and Tenoner.	Inside Moulder.
Closet stand 1	1.28	.....	.....	.....	1.70	.....	.....	0.21	0.18	0.09	.....	.....	.....	.....	.....	.....	.....
Bridges, gangplanks for freight houses 70	4.80	.....	.....	8.40	8.60	.....	.....	.....	.....	.....	4.80	11.40	.....	.....	.....	.....	.....
Blocking carriage 50	2.50	.....	.....	.....	.....	0.50	.....	.....	.....	.....	1.50	0.50	.....	.....	.....	.....	.....
Blocking, wreck trains.....4,000'	.....	.....	.....	.....	.....	108.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Barrel heads 25	0.08	.....	.....	.....	0.05	.....	0.20	.....	.....	.....	.....	0.17	.....	.....	.....	.....	.....
Boards, playing card..........36	3.00	.....	3.00	.....	.....	.....	.....	.....	.....	0.60	4.80	.....	.....	.....	.....	.....	.....
Carpenters' tool boxes.........36	3.00	.....	2.40	.....	.....	.....	0.90	2.10	1.80	1.80	.....	.....	.....	.....	.....	.....	.....
Desks, stand. office............½	0.83	.....	0.16	.....	.....	.....	.....	0.35	0.35	0.08	.....	.....	.....	.....	.....	.....	.....
Folder racks (pass. stations)....3	0.24	.....	.....	.....	1.41	0.24	.....	0.17	1.00	0.30	.....	.....	.....	.....	.....	.....	.....
Handles, brush and lant. hook.197	8.96	.....	4.76	.....	.....	.....	.....	.....	2.40	.....	.....	.....	.....	.....	.....	.....	.....
Horses, carpenter 48	7.32	.....	.....	.....	.....	14.72	.....	3.33	2.25	.....	.....	.....	.....	.....	.....	5.33	.....
Gages, car insp................2	1.65	.....	.....	.....	2.15	0.90	.....	2.20	2.30	.....	1.35	.....	.....	.....	.....	.....	.....
Keg heads 36	0.14	.....	.....	.....	0.14	.....	0.70	.....	.....	.....	.....	0.42	.....	.....	.....	.....	.....
Ladders— 8' ....36; 8'—15' ....10; 15'—20' ....5; 20'—30' 5	1.11	.....	.....	.....	.....	2.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Step 12	6.55	.....	.....	.....	.....	3.70	.....	1.80	1.50	0.40	0.72	.....	1.50	0.53	.....	.....	.....
Push car sills.................40	0.53	.....	.....	0.27	.....	0.26	.....	.....	.....	.....	0.68	0.93	.....	.....	.....	.....	.....
Pail bottoms for canvas colp. pails 24	.....	.....	.....	.....	0.11	.....	0.33	0.34	0.28	0.56	.....	.....	.....	.....	.....	.....	.....
Pickets, fence 50	0.14	.....	.....	.....	0.14	.....	.....	.....	.....	.....	.....	0.67	.....	.....	.....	.....	.....
Rollers, freight house........125'	.....	.....	.....	.....	.....	4.17	.....	1.57	.....	.....	.....	1.56	.....	10.40	.....	.....	.....
Signs, cinder 25	0.35	.....	.....	.....	0.17	.....	.....	0.52	.....	0.83	0.18	0.51	.....	.....	.....	.....	.....
Stretchers, cab. and bag. car...25	4.50	.....	.....	.....	.....	6.00	.....	3.00	2.50	.....	3.00	.....	3.00	6.50	.....	.....	.....
Window lifts 5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.14	.....	.....	.....	.....	.....
Wheel clubs 3	.....	.....	.....	.....	.....	0.18	0.90	.....	.....	.....	.....	.....	.....	.....	0.72	.....	.....
Wheel levers 12	0.40	.....	.....	.....	.....	0.40	0.60	.....	.....	0.80	.....	1.60	.....	.....	.....	.....	.....
Wedges 700	.....	.....	.....	4.67	.....	0.85	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flagsticks 1,660	20.59	.....	.....	.....	7.02	.....	.....	12.88	18.50	1.00	2.60	.....	6.30	3.09	.....	.....	9.15
Totals	69.97	.....	10.32	13.34	21.49	142.51	3.63	28.47	33.06	6.46	19.63	17.90	10.80	20.52	0.72	5.33	9.15

necessary part of the operation which must be included in the total and is not included in Tables 1 or 2.

Table Number 4 gives the machine tool time spent on various operations furnished on order for the various departments of the road, being material other than for car repairs.

In Table Number 5 will be found a summary giving a recapitulation of all the operations shown on Tables 1 to 4 inclusive, and brought together as a grand total in Column 5. Column 6 gives the load factor which was determined as follows:

Load factor = Total machine time ÷ (Number of tools x 26 days x 9 hours.)

Columns 5 and 6 are equated to an equivalent number of freight cars on the basis of five hours per car, which is found to be the average obtained from segregating the time consumed on freight cars, as given in Table 1 and divided by the number of freight cars comprehended in that table.

TABLE V—SUMMARY.

No. of Tools.	Column Number......	1 General repairs.	2 Material furnished outside points.	3 Material other than car repairs.	4 Time changing, adjusting, and sharpening tools.	5 Total machine time.	6 *Load factor.
4	Rip saws { 2—18″, 1—22″, 1—24″ }	292.68	35.38	67.97	23.30	419.33	0.45
1	Self-feed rip saw........	60.09	5.67	......	......	65.76	0.28
1	Comb. Rip & C. O. saw..	145.84	6.97	10.32	......	163.13	0.70
2	Edging saws	40.40	7.05	13.34	......	60.79	0.13
2	Swing C. O. saws.......	373.98	18.02	21.49	......	413.49	0.88
2	R'y C. O. saws..........	153.70	48.07	142.51	......	344.28	0.74
3	36″ band saws...........	223.83	21.21	3.63	......	248.67	0.36
2	Buzz planers, 16″—12″...	148.07	8.23	28.47	5.83	190.60	0.41
	Gainers and tenoners—						
1	Horz. car gainer....... }						
1	Comb. G. & T., double }	303.08	5.00	5.33	15.42	328.83	0.35
1	End tenoner .... }						
1	Small overhead gainer. }						
1	Double head shaper......	84.93	8.10	6.46	90.99	190.48	0.81
1	Inside moulder, 5″.......	60.37	8.30	9.15	12.63	90.45	0.39
1	Outside moulder, 8″.....	33.94	......	......	......	33.94	0.15
1	Gray & Woods planer, 36″	175.77	53.53	0.72	2.50	232.52	1.00
2	3-spindle vertical borers..	424.50	37.29	......	......	461.79	0.98
1	1-spindle horizontal borer.	27.12	9.28	19.63	......	56.03	0.24
1	Horizontal H. C. mortiser	46.94	......	......	......	46.94	0.20
1	Vertical H. C. mortiser..	187.99	21.00	......	......	208.99	0.90
1	Rotary bed planer.......	137.13	40.91	17.90	2.50	198.44	0.85
1	Single surfacer, 24″.....	174.39	10.26	33.06	2.50	220.21	0.94
1	Sash and blind tenoner...	55.19	......	......	38.25	93.44	0.40
1	Panel machine	4.13	3.33	......	......	7.46	0.03
1	Sash and door mortiser..	56.64	......	......	4.15	60.79	0.26
1	Berlin 4-side tim. planer.	151.98	12.40	......	58.40	222.78	0.95
1	Jig saw	7.16	1.00	......	......	8.16	0.03
1	Dowel machine	6.23	......	10.80	13.33	30.36	0.13
1	Lathe	0.93	......	20.52	......	21.45	0.09
1	Daniels planer, 24″......	2.40	......	......	......	2.40	0.01
1	Saw mill (resaw)........	11.83	......	......	......	11.83	0.05
1	Matcher	54.17	13.33	......	6.56	74.06	0.31
	Total machine hours...	3,445.41	374.33	411.30	276.36	4,507.40	0.46 Avg.
	Equivalent cars—						
	Freight	550	80	84	......	714	....
	Passenger	70	......	......	......	70	....

$$\text{* Load factor} = \frac{\text{Total machine hours (Col. 5).}}{\text{Number tools} \times 26 \text{ days} \times 9 \text{ hours.}}$$

Approximate hours per month.......	Passenger car	5.84
	Freight car	6.00

A study of tables of this character prepared for any shop now in operation will readily show which tools are being used to full capacity and which are lying idle the larger part of the time. It will often permit the rearrangement of the work so that a single tool can be made to do the duty of two or three, or on the other hand it will show just what new equipment will be necessary to increase the capacity of the shop.

The ideal load factor is very greatly influenced by certain machines and operations that are, from the nature of the case, intermittent and infrequent in their operation and scope, which particular machines would be required if only 50 cars were repaired and yet, are capable of handling work of the character adapted to these particular machines for 500 or more cars, just as in a locomotive shop, a driving wheel lathe that could handle the tire turning for 500 locomotives per year would be required in a smaller shop handling only 50 engines a year. Consequently considerable judgment and experience is necessary in pro-rating or focusing the results of such an analysis as the foregoing to comprehend or apply to the needs or requirements of shops of different or varying capacities.

TENDER DERAILMENTS

The following diagnosis of the cause of tender derailments is taken from a letter from E. W. Summers, president of the Summers Steel Car Company, Pittsburgh, Pa., which was published in the *Railway Age Gazette* of September 27, 1912. Very few problems have given so much trouble to railway officers as has that of tender derailments, and Mr. Summers gives a simple and logical reason of its cause and suggestions as to the solution of the difficulty. He says:

"It is easy enough to know the cause of a wreck where there is a collision, or a switch is left open, but on a straight track with rails apparently in normal condition, the problem is different. Note the phrase, "apparently in normal condition." After the wreck, with the rails and cross ties all torn up and the ballast swept away, investigation proves little or nothing. Everything is so twisted that we cannot tell what happened first. Whether the report is "rails spread," or "defective rail," or "cause unknown," it is all the same—we learn nothing from it. With the track absolutely straight and solid it will not happen, but you cannot keep a track in such a condition.

"The trouble is that we are shooting thousands of tons along the track at almost cannon ball speed and attempting to deflect its course without making provision for the resistance necessary to cause such deflection. In rounding curves provision is made for the reaction necessary to change the course of the train, but slight kinks occur in straight track without provision for taking care of the disturbance set up. Lateral kinks in the rails are provided for by loose fits of journals and journal bearings and swing or roller motion devices which permit the wheels to move sideways, back and forth, without deflecting the main mass of the car body from its line of travel. Vertical irregularities are *usually* taken care of by the truck springs which permit the wheels to move up or down relative to the car body without changing its course.

"There are times, however, when by reason of violent side rocking of the car body or traversing a warped track surface, the truck springs are compressed solid, and when this happens coincident with a vertical change in the rail surface, the whole of the loaded car has to be deflected from its course. This causes a portion of the stored energy of the moving car to be converted into vertical impact on the rail. Let us analyze this:

"Take the weight centered at the axis of a wheel on an engine tender, say 2,000 lbs., which includes wheel, axle, journal box and contents. This mass or weight moving along the track at the rate of a mile a minute or 88 feet per second, will have a stored energy of 242,000 ft. lbs. This amount is arrived at as follows:

$$\frac{2{,}000 \times 88 \times 88}{64.4} = 242{,}000$$

"In Fig. 1 the 242,000 ft. lbs. measured off at a-b is shown graphically. The wheel runs against an obstruction of the rail at E, the point of contact being at an angle of 45 deg. from the line of travel through the center of mass at a. Drawing a line from a to E we have the line of resistance, and a line drawn perpendicular to a-E and passing through b intersects a-E at c. The line c-d represents the vertical reaction at E equal to 121,000 ft. lbs., and a-d represents the horizontal reaction at E equal to

121,000 ft. lbs. They are both equal because the resistance contact point E is at an angle of 45 deg. with the line of force a-b. Fig. 1 was considered with the obstruction at an angle of 45 deg. with the line of force in order that the force diagram might be easily understood. It is an exaggeration of conditions and would be sure to cause a wreck.

"Fig. 2 shows a condition that is likely to be found at crossings or frog points, where the point of the frog comes in contact with the wheel tread about 4 in. in advance of the center of the wheel. With this condition, the 242,000 ft. lbs. is measured at a-b. A line is now drawn through b perpendicular to a-E at c. Then d-c, 53,000 ft. lbs., equals the vertical reaction at E; and a-d, 12,500 ft. lbs., equals the horizontal reaction at E. This

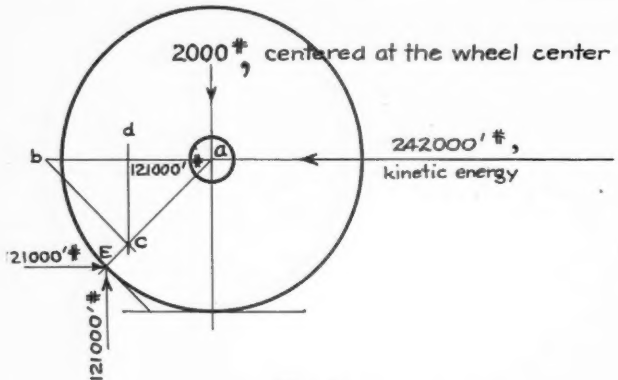


Fig. 1.

is the case when the mass in moving along the rail has to lift only the wheel load of 2,000 lbs. over the slight elevation at E. In other words, the wheel raises that slight amount so quickly that the great mass of the car body and its load is not moved up at all, the truck springs absorbing the wheel movement.

"This cannot occur if, from side swaying of the car body, the truck springs are compressed solid at a time coincident with the wheel coming in contact with the frog point. In that case the greater mass of the car body must move up with the wheel and the mass lifted may be 20,000 lbs. instead of 2,000 lbs. The vertical and horizontal reaction at E will be increased in the

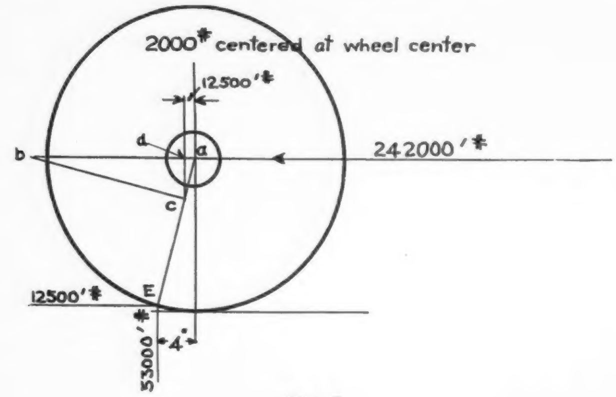


Fig. 2.

ratio as 2,000 is to 20,000, or 10 times as great, the vertical reaction being 530,000 ft. lbs., and the horizontal 125,000. In this case the vertical and horizontal reactions at E are produced because of the 20,000 lbs. resistance against the upward movement of the wheel, but the force that is pushing the wheel along the track is applied to the truck through the center plate; the wheel striking the frog point is retarded by an unbalanced force of 125,000 ft. lbs., while the one on the other end of the axle has no obstruction, *the two ends of the axle and their wheels must therefore travel on at different velocities.*

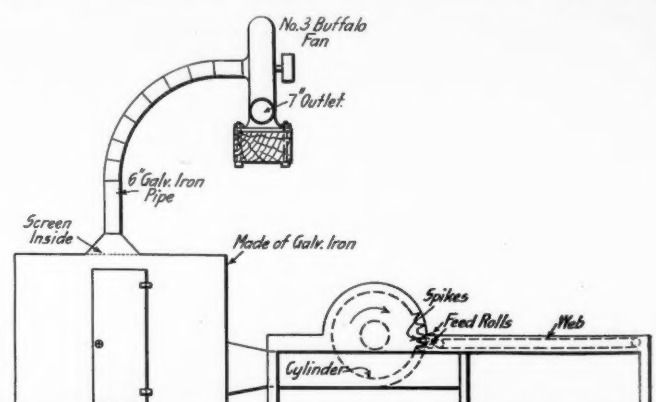
"What is the result? Derailment, either from *rails spreading*, or the *wheel flange crossing over the rail*, or *something breaks.* It's all the same, the train is ditched and somebody gets busy with a report on the cause of the wreck.

"The real cause is *defective equipment—defective in design;* defective because of the gradual increase in load and speed of trains without taking into account the necessity for flexibility between the truck and the heavy rigid car body. The engine boiler has been taxed for heating, lighting, braking, signaling, more tonnage and higher train speed. The engine tender has been built higher, longer and heavier, its center of gravity being in some cases as high as 8 ft. above the rail, its spring capacity almost nil. Too much spring movement causes too much rocking with this high center of gravity.

"Wreck after wreck has occurred from this cause, often attended with loss of life. The example of a frog point obstruction shown in Fig. 2 is only used as a basis of calculation. The defective track may be a low or high joint, a loose joint with one rail having a solid support and the other not. There are many conditions of frozen or frost heaved track that produce the result. The unbalanced horizontal and vertical reactions may be more or less than in the example. What I wish to call attention to is the *fact that there is an unbalanced reaction on the wheel, sufficient to slew the truck,* which will either spread the rails or break a wheel flange, or cause the flanges to mount the rail and go over, or something gives way from the excessive stress set up which causes derailment, and that *it can be remedied by a more flexible connection between the truck and the car* which does not permit of the concentration of all the load on half the springs or wheels."

DUST REMOVER FOR HAIR PICKING MACHINE

Machines for cleaning the hair and moss stuffing used in seat cushions, particularly those in locomotives and cabooses, are usually very disagreeable for the operator and others in the vicinity because of the large amount of dust that is thrown in the air. W. W. Warner, assistant general foreman of the Kent, Ohio, shops of the Erie, has arranged a dust collector which overcomes this difficulty and at the same time improves the efficiency of the machine as a cleaner. It consists of a large galvanized iron box which is connected to the picking



Suction Blower on a Hair Picking Machine.

machine by a sheet iron cylinder, so arranged that after the material leaves the machine it drops in it. Except for this opening the cylinder is air tight. There is a connection from the top of the iron box to a No. 3 Buffalo fan which operates as an exhauster and creates a partial vacuum inside the box and in the cylinder extending to the cleaning machine. The hair or moss when cleaned is sucked in the box and the dust and dirt is drawn up through the fan and discharged outside the building. There is a screen across the suction of the fan which prevents any of the material escaping from the box.

New Motive Power on the Santa Fe

Seventy Locomotives of Four Types Have Recently Been Put in Service, Including Twenty Balanced Compounds.

The Atchison, Topeka & Santa Fe has recently received 70 locomotives of the following types from the Baldwin Locomotive Works:

20 Santa Fe type for oil burning.
10 Pacific type for oil burning.
10 Pacific type for coal burning.
10 consolidation for oil burning.
14 switching for oil burning.
6 switching for coal burning.

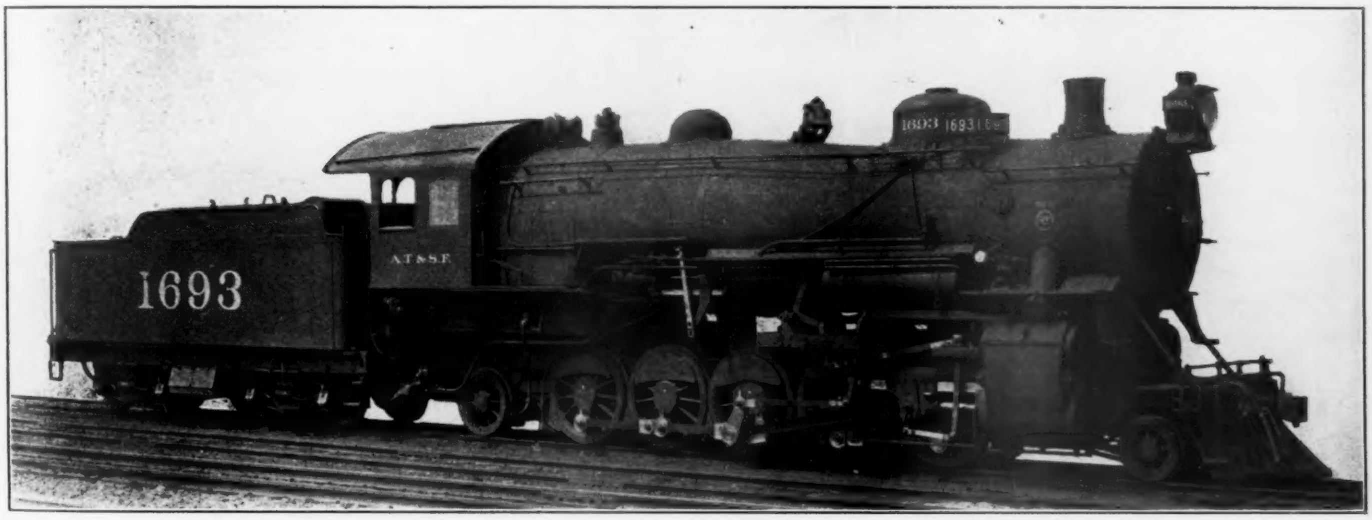
In general, the new locomotives are very similar to those of the same types already in service. The differences between the former engines and the new ones are due to the general development in locomotive design and to changes made necessary by minor weaknesses, or by local conditions. While the new power represents the latest development in locomotive construction, the various details so far as possible are interchangeable with corresponding parts of the older locomotives. In most instances where revision of design of individual parts has been necessary because of weakness, the new parts have been made interchangeable with the corresponding parts of older engines, thus reducing the number of patterns as well as the amount of repair material required for stock.

The boilers of all the new engines have radial stay fireboxes and all the locomotives for road service are equipped with Schmidt superheaters. The reversion in this order, to the 2-10-2 type locomotive for heavy freight service is a matter of considerable interest, indicating, as it does, the success achieved by the former engines of this type. The retention of the balanced compound in heavy duty passenger service is also noteworthy. These locomotives are among the most highly developed thus far built, and their successful performance can safely be assured. A more detailed discussion of the principal features of the various classes follows:

SANTA FE TYPE.

The first locomotives with this wheel arrangement were placed in service on the Santa Fe in 1903, and during the years 1903-1907, a total of 160 locomotives of this type were built by the Baldwin Locomotive Works for service on the mountain divisions. Some of these engines have undergone extensive alterations since they were first constructed, and several have been converted to Mallet compounds by the addition of forward units.* The new locomotives are of the same general design as those previously built. The most notable change lies in the use of superheated steam in single expansion cylinders instead of saturated steam in tandem compound cylinders and a slight increase in weight due chiefly to the use of a larger boiler. The shell diameter at the front end, has been increased from 78¾ in. to 80¾ in., and the tubes have been lengthened from 20 ft. to 21 ft. The grate area and other firebox dimensions, however, are practically unchanged.

The superheater is of the Schmidt type, with 36 elements, placed in as many 5½ in. flues. The steam piping is arranged in accordance with recent practice, and superheated steam is delivered direct to the steam chests through outside pipes. Inside admission piston valves, 16 in. in diameter, control the steam distribution. These valves are driven by the Walschaert gear and are set with a lead of ¼ in. The Ragonnet power reverse mechanism has been applied as a result of continued trial on previous engines of other classes. The main cylinders are oiled by a five-feed lubricator which has a lead to each steam pipe and one to each cylinder barrel.

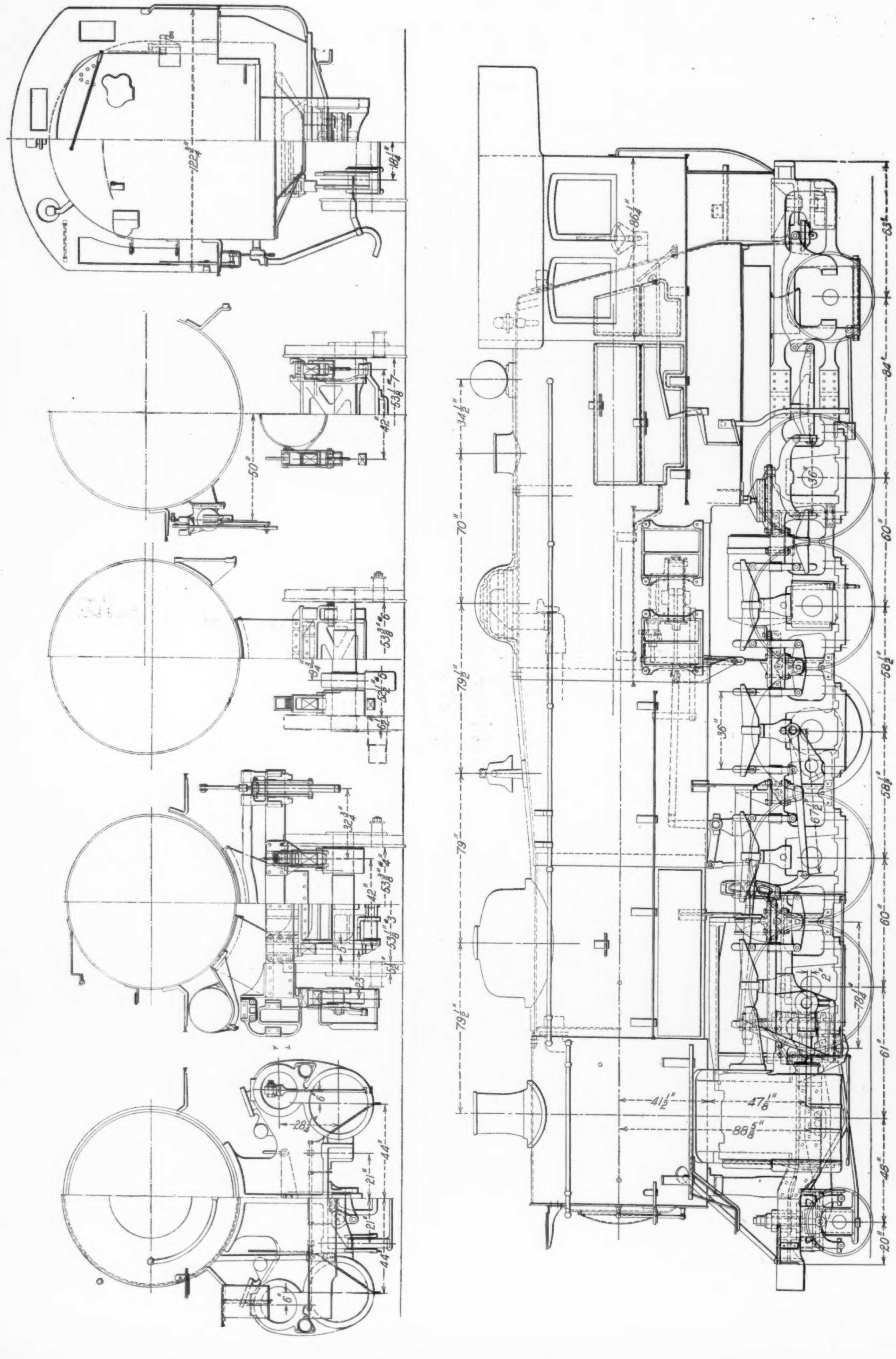


Powerful Simple Freight Locomotive of the 2-10-2 Type for the Santa Fe.

The frames are of 40 point carbon steel, with main sections 5 in. wide cast in one piece with single front rails. Transverse braces of cast steel are placed midway between the adjacent pairs of driving pedestals, except at the rear where the brace is placed close to the fifth driving axle. This brace forms a seat for the sliding shoes which support the front end of the firebox. Just back of the fifth pair of pedestals the rear frames are spliced to the main frames. The rear truck is of the Rushton type with inside journals, the same as has been applied to the previous engines of the same general design. The back end of the firebox is supported on an expansion plate bolted to the foot plate.

Due provision has been made for bracing the frames at the front end. Just forward of the cylinders they are secured to a cast steel deck-plate; while between the cylinders and the leading driving pedestals is a most substantial transverse brace of cast steel which supports the driving brake shaft. The brake cylinders are bolted to the guide yoke. Each guide bearer is

* See *American Engineer and Railroad Journal*, May, 1911, page 171.

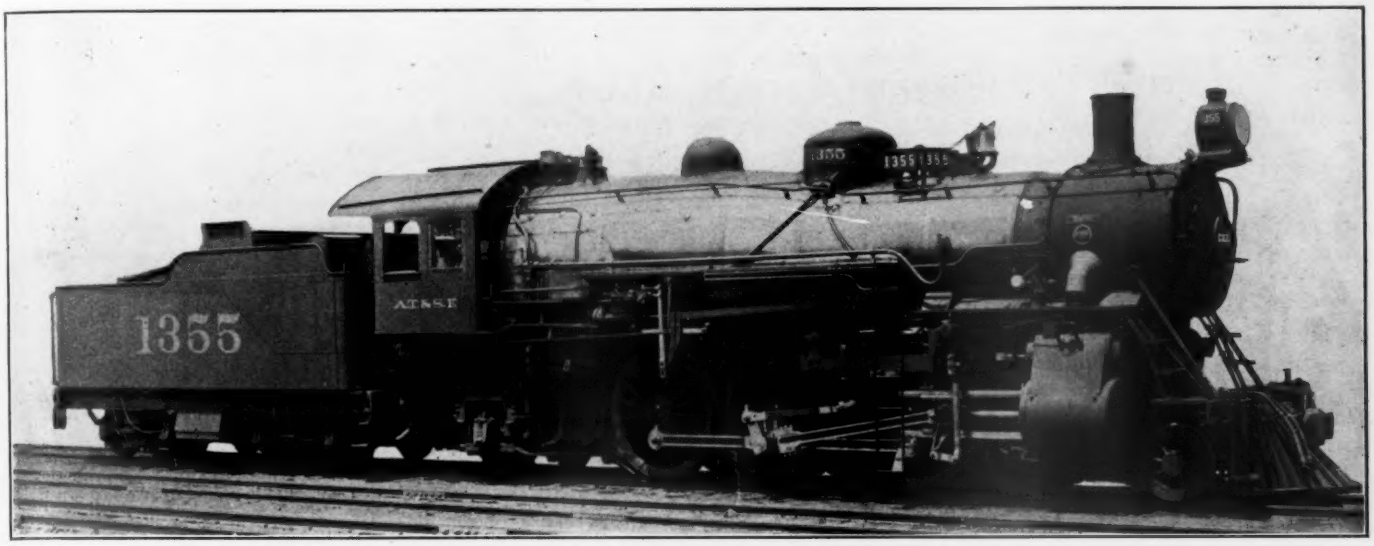


Simple Santa Fe Type Locomotive, with Schmidt Superheater; Atchison, Topeka & Santa Fe.

braced by a longitudinal cast steel tie, which is bolted at its forward end to the top of the steam chest.

As in the ten-coupled locomotives of the Santa Fe type recently built for the Chicago, Burlington & Quincy* counterweights are keyed to the main axle between the frames to compensate for deficiency of weight in the wheel centers.

The equipment of these locomotives includes cylinder relief valves, as well as drifting valves of the Sheedy pattern. Flange lubricators are applied to the leading pair of driving wheels. The oil-burning equipment is in accordance with the railway company's practice. A 2 in. Booth burner is used and it is placed in the forward end of the firebox.



Balanced Compound Pacific Type Locomotive With Superheater for the Santa Fe.

PACIFIC TYPE.

These locomotives are generally similar to the twenty-eight balanced compound Pacific type engines built for this road last year by the Baldwin Locomotive Works.† The tractive effort, working compound, is 34,000 lbs.

The inside or high pressure cylinders are placed on an angle of 7½ deg., with their centers 26¾ in. above the outside cylinder centers, measured on the vertical center line of the cylinder casting. The high pressure piston rods are somewhat shorter than the low pressure, in order to allow sufficient clearance between the main rods and the first driving axle. When the inside cranks are on the back dead center, the crossheads are immediately above this axle. The inside guides are of the Laird type, this design having been adopted because it provides a maximum amount of clearance under the crossheads. These guides are supported in front by the yoke which braces the outside guides and is independent of the back cylinder heads. At the back they are bolted to a substantial steel casting which extends the full depth of the leading driving pedestals. This casting has two openings formed in it, through which the high pressure main rods pass. Immediately in the rear of this casting, the upper frame rails are braced by the valve motion bearer. Another brace, a short distance ahead of the rear driving pedestals, is bolted to both the upper and lower frame rails. The transverse bracing of the frames in a four cylinder balanced engine presents some difficult problems, but in the locomotive under discussion a most satisfactory arrangement has been worked out.

New Superheater Consolidation Locomotive for the Santa Fe.

The design of the superheater calls for no special comment. The steam pipes pass out through the sides of the smoke-box and deliver steam directly to the steam chests. The construction of the cylinder castings is thus materially simplified, the

* See *American Engineer*, May, 1912, page 231.
† See *American Engineer*, February, 1912, page 65.

more so as the valves are arranged for inside admission to the high pressure cylinders. Walschaert motion is used, and as the gears are driven from the outside pins they are arranged in the same manner as when using outside admission valves on a single expansion locomotive. The gears are controlled by the Ragonnet power mechanism.

The coal burning locomotives are equipped with brick arches, and the grates and fire-door are operated by pneumatic power. The ash pan has three hoppers, with swing bottoms which can be operated independently of each other. Special attention has been given to equipping the locomotives so that they can be conveniently handled.

CONSOLIDATION LOCOMOTIVES.

These locomotives exert a tractive effort of 48,800 lbs. and carry an average weight of nearly 49,000 lbs. on each pair of driving wheels. The general design is based on that of consolidation engines which were placed in service by the Santa Fe in 1908.* The weight has been somewhat increased, due to enlarging the boiler to accommodate the superheater.

A wagon-top boiler with wide firebox is used in this design, and the front portion of the mudring is sloped to secure sufficient depth at the throat. The staybolts are so spaced that a brick arch with water tubes can be applied, if at any time it is desired to change the locomotives to coal burners.

As in the other road engines, the superheater is arranged with outside steam pipes, and the valves are driven by Walschaert gear. In the present instance, the link and reverse shaft bearings are bolted to the guide bearer. The combining levers are pinned directly to the valve stems. A longitudinal bearer is placed on each side of the locomotive, and is supported between the cylinder casting and the guide yoke. To this bearer is bolted a bracket which supports the valve rod crosshead. This arrangement provides an efficient brace for the guide yoke, in addition to a valve rod support which is independent of the main guides.

The frames are 4½ in. wide, with double front rails. A transverse brace, extending the full depth of the pedestals, is placed midway between the second and third, and third and fourth axles respectively. The firebox is supported by sliding shoes in front and an expansion plate at the back.

SWITCHING LOCOMOTIVES.

These engines are all equipped with Stephenson link motion, the steam distribution being controlled by 12-in. piston valves. They have wagon-top boilers with long fireboxes placed above the frames. The cylinders are 20 in. x 26 in., and with 51 in. wheels and a steam pressure of 180 lbs.; the tractive effort is 31,200 lbs. The total weight, equipped for coal burning, is 154,000 lbs. The design is one which the Santa Fe has used in general switching service with very satisfactory results.

The general dimensions of the road engines are given in the following table:

TYPE.	2-10-2	4-6-2	2-8-0
Gage, ft. & in.	4-8½	4-8½	4-8½
Service	Freight	Passenger	Freight
Fuel	Oil	Coal or Oil	Oil
Tractive effort, lbs.	63,580	34,000	48,800
Weight in working order, lbs.	295,900	268,500	226,300
Weight on drivers, lbs.	248,900	163,500	195,500
Weight on leading truck, lbs.	21,400	54,600	30,800
Weight on trailing truck, lbs.	25,600	50,700	......
Weight of engine and tender in working order, lbs.	470,000	440,000	385,000
Wheel base, driving, ft. & in.	19-9	13-8	15-6
Wheel base, total, ft. & in.	35-10	35-1	24-6
Wheel base, engine and tender, ft. & in.	66-4	61-11	58-3
RATIOS.			
Weight on drivers ÷ tractive effort	3.92	4.80	4.00
Total weight ÷ tractive effort	5.66	7.80	4.63
Tractive effort x diam. drivers ÷ equivalent heating surface	630.00	570.00	748.00
Equivalent heating surface ÷ grate area	95.60	75.80	78.30
Firebox heating surface ÷ equivalent heating surface, per cent.	3.36	4.80	5.38
Weight on drivers ÷ equivalent heating surface	43.30	37.30	52.80
Total weight ÷ equivalent heating surface	51.50	61.30	61.00
Volume both cylinders, cu. ft.	22.70	12.10†	16.10
Equivalent heating surface ÷ vol. cylinders	253.00	358.00	231.00
Grate area ÷ vol. cylinders	2.57	4.72	2.92
CYLINDERS.			
Kind	Simple	Compound	Simple
Diameter and stroke, in.	28 × 32	17½ & 29 × 28	23½ × 32
Kind of valves	Piston	Piston	Piston
Diameter of valves, in.	16	15	......
WHEELS.			
Driving, diameter over tires, in.	57	73	57
Driving, thickness of tires, in.	3½	3½	3½
Driving journals, main, diameter and length, in.	11 × 12	11 × 10	10 × 12
Driving journals, others, diameter and length, in.	10 × 12	9 × 12	9 × 12
Engine truck wheels, diameter, in.	29¼	34¼	29¼
Engine truck journals, in.	6½ × 10½	6 × 10	6½ × 10½
Trailing truck wheels, diameter, in.	40	50	......
Trailing truck journals, in.	7½ × 12	8 × 14	......
BOILER.			
Style	W. T.	W. T.	W. T.
Working pressure, in.	170	210	185
Outside diameter of first ring, in.	80¾	70	78¾
Firebox, length and width, in.	108 × 78	109⅝ × 76¼	95½ × 71¼
Firebox plates, thickness, in.	⅜ & 9/16	⅜ & 9/16	⅜ & ½
Firebox, water space, in.	6	F & S-5, B-4½	F-4½, S & B-4
Tubes, number and outside diameter, in.	251-2¼	199-2¼	256-2
Flues, number and outside diameter, in.	36-5½	26-5½	34-5⅜
Tubes, material and thickness	Iron No. 11	Iron No. 11	Iron No. 11
Flues, material and thickness.	Iron No. 9	Iron No. 9	Iron No. 9
Tubes, length, ft. & in.	21-0	21-0	14-9
Heating surface, tubes, sq. ft.	4,174	3,233	2,658
Heating surface, firebox, sq. ft.	193	210	200
Heating surface, total, sq. ft.	4,367	3,443	2,858
Superheater heating surface, sq. ft.	910	619	565
Equivalent heating surface, sq. ft.*	5,732	4,371	3,706
Grate area, sq. ft.	58.5	57.6	47.2
TENDER.			
Wheels, diameter, in.	34¼	34¼	34¼
Journals, diameter and length, in.	5½ × 10	5½ × 10	5½ × 10
Water capacity, gals.	9,000	9,000	8,500
Coal capacity, tons or gals.	3,300	12	3,300

* Equals evaporating heating surface plus 1.5 times superheater surface.

† Equivalent simple cylinders.

* See *American Engineer and Railroad Journal*, March 1908, page 112.

Passenger Traffic.—The revenue received from passengers carried on the railways in the United States during the year ended June 30, 1911, was $997,409,882, which is an increase of $25,726,683 over that of 1910.

Passenger Traffic at C. & N. W. Chicago Terminal.—The Chicago & North Western has compiled figures showing that the total number of arrivals and departures at its new Chicago passenger terminal during the first year since the station was opened on June 4, 1911, was 18,797,500, an average of 51,500 per day. During May, 1912, 47,215 persons were served in the lunch room and dining room, while the total for the year was 585,200. The volume of United States mail moving in and out of the terminal has averaged 150 tons a day.

Exhaust Steam Injector.—On some of the English locomotives an injector is being applied, which is operated by steam taken from the exhaust pipe. These injectors are of the non-lifting type and capable of feeding against a pressure of 120 lbs. per sq. in. with exhaust steam only. A small supplementary live steam jet is also included in the latest design introduced by Davis & Metcalfe, Ltd., which enables the injector to feed against pressures up to 300 lbs. per sq. in. They operate on the same principle as a high pressure injector and have two draft tubes and a combining nozzle. The exhaust steam passes through an oil separator before reaching the injector. The combining nozzle is constructed on the flap nozzle system. The auxiliary live steam connection is of sufficient size to operate the injector when the locomotive is standing.

MAINTENANCE OF LOCOMOTIVE BOILERS

Rules and Instructions for Washing-Out, Inspecting and Testing of the Boiler and Its Appurtenances.

BY WALTER R. HEDEMAN

In order to maintain locomotive boilers in the highest state of efficiency, it is necessary that they be washed out, inspected, and tested at regular intervals. Aside from the maintenance standpoint the performance of these functions is compulsory according to the federal boiler inspection laws for the promotion of the safety of employees and the traveling public.

To do the work in a systematic manner, uniform rules and instructions should be issued to all concerned to govern them in the various operations. Not only is it necessary for the washing-out, inspection, and testing to be done regularly, as specified in the rules, but an accurate record must be kept of all work done, so that at all times the officer under whose supervision a locomotive is, will know whether a boiler is due for any of the above operations. To facilitate the washing out the mechanical department should provide all boilers with suitably located wash-out plugs.

Form

B. & O. R. R. CO.

MOTIVE POWER DEPARTMENT.

LOCOMOTIVE NUMBER ____________

THE BOILER OF THIS LOCOMOTIVE WAS WASHED OUT, THE GAGE COCKS AND WATER GLASS COCKS WERE CLEANED AND THE SAFETY VALVES WERE TESTED AND SET O. K. AS INDICATED BELOW:

Engine House.	Work Performed.	Date.	Signature of Inspector.
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		

Date Taken Out of Service

Date Placed in Service

See Other Side

FACE OF CARD.

Engine House.	Work Performed.	Date.	Signature of Inspector.
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		
	Boiler Washed		
	Gage and Water Glass Cocks Cleaned		
	Safety Valves Tested and Set O. K.		

Date Taken Out of Service

Date Placed in Service

Note—One of these cards, properly filled out, must be placed in cab of each and every locomotive in service and forwarded every three months (at the time the quarterly inspection is made) to the Supt. of Motive Power or Division Master Mechanic for his record.

Master Mechanic.

See Other Side

BACK OF CARD.

Fig. 1.—Arrangement of Boiler Inspection and Washout Card Which Is Kept in the Locomotive Cab.

GENERAL INSTRUCTIONS.

Each locomotive in service must be provided with a record card similar to the one shown in Fig. 1, which is to be kept in a metal box as shown in Fig. 2. This is located in the cab as shown in Fig. 3. As inspectors do the work called for on the card, the engine number, station where work is done, date when done, as well as the name of the one doing the work, should be entered in their proper places, and the card placed in the card box in the cab.

The boiler inspector at each station must keep a book record of the date of washing-out and also of the examination and staybolt test of each locomotive boiler; this in addition to the individual record kept in cab and card box. At the same time he must fill out the regular staybolt test report form, which is illustrated in Fig. 4.

The boiler inspectors at each station should make up daily a list of locomotives that are due for washing out, testing and examination of staybolts; these lists should be brought to the attention of the engine despatchers, leading hostlers, boiler washers, and all others concerned. The leading hostlers and others employed at the ash pits should also make an examination of the card record in the card box in the cab of each incoming locomotive, and keep informed as to whether the fires should be knocked on account of washing-out or because of the staybolt test being required. They should also notify the boiler inspector and others concerned when they find home or foreign division locomotives for which this work is due.

When a locomotive assigned to one division may be in temporary service on another, the master mechanic of the division on which the locomotive is assigned must notify the master mechanic of the division on which the locomotive is in service of the times that the boiler wash-out, staybolt test and boiler examination are to be performed.

INSTRUCTIONS FOR THE WASHING-OUT.

Locomotive boilers as a rule should be washed at least once during the following periods: Passenger and freight locomotives once every 10 days; switching and helping locomotives once every 15 days. These periods should be lengthened or

shortened wherever advisable, and the weather, service, or mileage conditions justify.

The following methods should be adhered to in washing out locomotive boilers. Blow out the boiler through the blow-off cock until the water has been discharged, after which the blow-off cock should be closed to retain the remaining steam pressure until the staybolts have been tested. After the staybolt test the blow-off cock should again be opened to let out the remaining steam and water. When all the water and steam have been blown out, the washout plugs and hand hole plates should be removed.

Wash out the water legs, as well as around the firebox flue

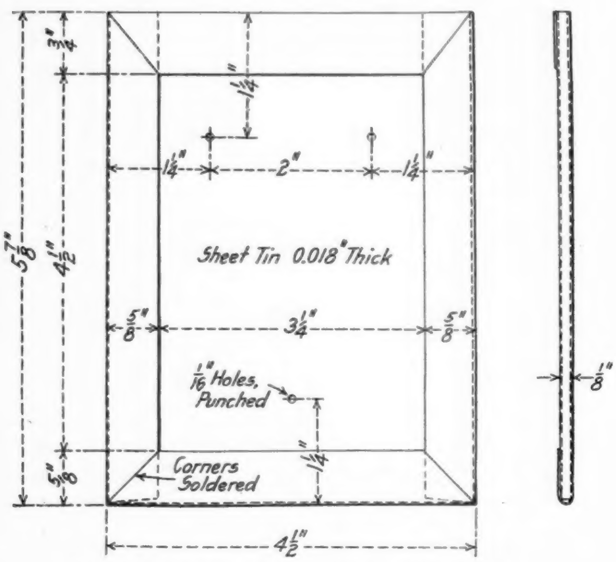


Fig. 2—Box for Holding Boiler Washout Card.

sheet and the furnace door opening. Wash off the crown sheet, the top of the flues, and the cylindrical portion of the boiler, beginning at the smokebox end and following back by washing through the holes in the sides and at the bottom of the shell. Repeat the washing out of the boiler legs, and over the fire door neck to remove the scale that has been washed down from the top of the crown sheet and flues.

Coat the threaded portion of the washout plugs with a mixture of graphite and black oil, and reapply the washout plugs and hand hole plates and fill the boiler. Wherever possible heated water should be used for washing out and filling the boilers. Under no circumstances should the crown sheet be washed before the boiler legs have been washed.

INSPECTION OF BOILERS.

The interior of every boiler should be thoroughly inspected before it is put in service, and whenever a sufficient number of flues are removed to allow examination. All flues of boilers in service, except as otherwise provided, should be removed at least once every three years, and a thorough examination should be made of the entire interior of the boiler. After the flues are taken out the inside of the boiler must have the scale removed and be thoroughly cleaned. The entire interior of the boiler must then be examined for cracks, pitting, grooving, or indications of overheating and for damage where mud has collected, or heavy scale formed. The edges of plates and all laps, seams and points where cracks and defects are likely to develop, or which an exterior examination may have indicated to be weak, must be given an especially minute examination.

It must be seen that braces and stays are taut, that pins are properly secured in place, and that each is in condition to support its proportion of the load. Any boiler developing cracks in the barrel must be taken out of service at once, thoroughly repaired, and reported to be in satisfactory condition before it is returned to service. Every boiler having lap joint longitudinal seams without reinforcing plates should be examined with especial care to detect grooving or cracks at the edges of the seams.

If boilers are equipped with fusible plugs they must be removed and cleaned of scale at least once every month. The exterior of every boiler should be thoroughly inspected before it is put in service, and whenever the jacketing and lagging are removed. The jacketing and lagging should be removed at least once every five years, and a thorough inspection made of the entire exterior of the boiler. The jacketing and lagging should also be removed whenever, on account of indications of leaks, the inspector considers it desirable or necessary.

RULES FOR TESTING BOILERS.

All locomotive boilers must be subjected to a hydrostatic pressure of 25 per cent. above the rated working pressure before being placed in service. This test must be made not less than once each six months, and the water must be heated to about the boiling point immediately before pressure is applied. When it is being made an authorized representative, who is thoroughly familiar with boiler construction, must personally witness the test and thoroughly examine the boiler while under test.

A record of each hydrostatic test must be made on a standard form, Fig. 4, provided for the purpose; each item on the blank must be filled in and the form signed by the authorized representative witnessing the test, who must add in the space provided for remarks anything worthy of note. The date of all hydrostatic tests must be given promptly to the superintendent of motive power by the master mechanics, duplicates of the forms to be kept at the station where the test is made, and a book record kept in the office of the master mechanic.

STAYBOLT TEST.

The staybolts of locomotives in service must be tested not less frequently than once each 15 days. Staybolts must also be tested immediately after each hydrostatic test. When these tests are made, there must not be less than 50 lbs. of

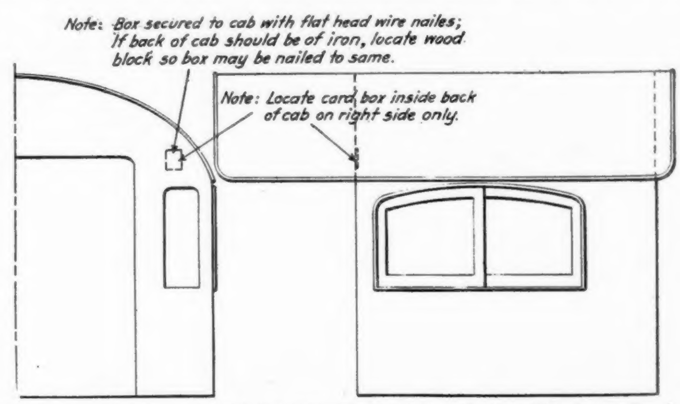


Fig. 3—Location in Cab of Box for Holding Boiler Washout Card.

steam pressure on the boiler, which will produce a sufficient strain on the staybolts to cause the separation of the parts of broken ones. If the boiler is not under steam, the examination may be made after drawing all the water from the boiler.

An inspector especially trained for the service must tap with a hammer each staybolt and crown sheet stay accessible on the firebox end, and those not accessible must be tapped whenever possible on the outside end. Staybolts having tell-tale holes must, in addition to the hammer test, be carefully inspected to insure that all of the tell-tale holes are open, using a drill for this purpose when necessary. No boiler may be allowed to remain in service when there is more than one broken staybolt in any part of the firebox.

All tell-tale holes in staybolts must be thoroughly cleaned by a drill before the hydrostatic test, and when the locomotives

are in the shop for classified repairs. All staybolts must have tell-tale holes drilled 3/16 in. diameter by 1¼ in. deep, and the crown sheet stays must be so drilled when specified.

Flexible staybolts must undergo a special examination not less frequently than once each 18 months, by removing a number of caps in different locations for examination of sleeves and bolts, preferably while the locomotives are in the shop for classified repairs, and prior to the hydrostatic test.

Precautions must be taken to insure the removal of all defective bolts, and a careful examination must be made of bolts adjacent to the broken ones.

The staybolt inspector must keep an accurate record of the

Report of Staybolt Test and Firebox Inspection.

Locomotive boiler No. .... Class............. At ....Station.

Date .... Examined by ....

Show Location of Entirely Broken Staybolts by Marking X in Black. Show Partially Broken Staybolts by Marking X in Red on Diagrams.

Number of staybolts found entirely broken in right side sheet.................... Number renewed.....................

Number of staybolts found partially broken in right side sheet.................... Number renewed.....................

Number of staybolts found entirely broken in left side sheet.................... Number renewed.....................

Number of staybolts found partially broken in left side sheet.................... Number renewed.....................

Number of staybolts found entirely broken in backhead sheet.................... Number renewed.....................

Number of staybolts found partially broken in backhead sheet.................... Number renewed.....................

Number of staybolts found entirely broken in throat sheet.................... Number renewed.....................

Number of staybolts found partially broken in throat sheet.................... Number renewed.....................

Number of staybolts found entirely broken in crown sheet.................... Number renewed.....................

Number of staybolts found partially broken in crown sheet.................... Number renewed.....................

Total number of entirely broken staybolts.................................... Total number renewed...............

Total number of partially broken staybolts.................................... Total number renewed...............

Date staybolts were renewed..............................Condition of furnace door sheet....................

Are all staybolts drilled with tell-tale holes?....................Condition of firebox tube sheet ....

Were renewed staybolts drilled with tell-tale holes?...............Condition of furnace door ring ....

Number of staybolts found with tell-tale holes obstructed...........Condition of mud ring ....

Were all obstructed tell-tale holes cleaned out or redrilled?..........Condition of boiler tubes ....

Condition of crown sheet ....Condition of arch tubes............................

Condition of crown sheet staybolts ....Condition of boiler washout and arch tube plugs and hand hole plates.........................

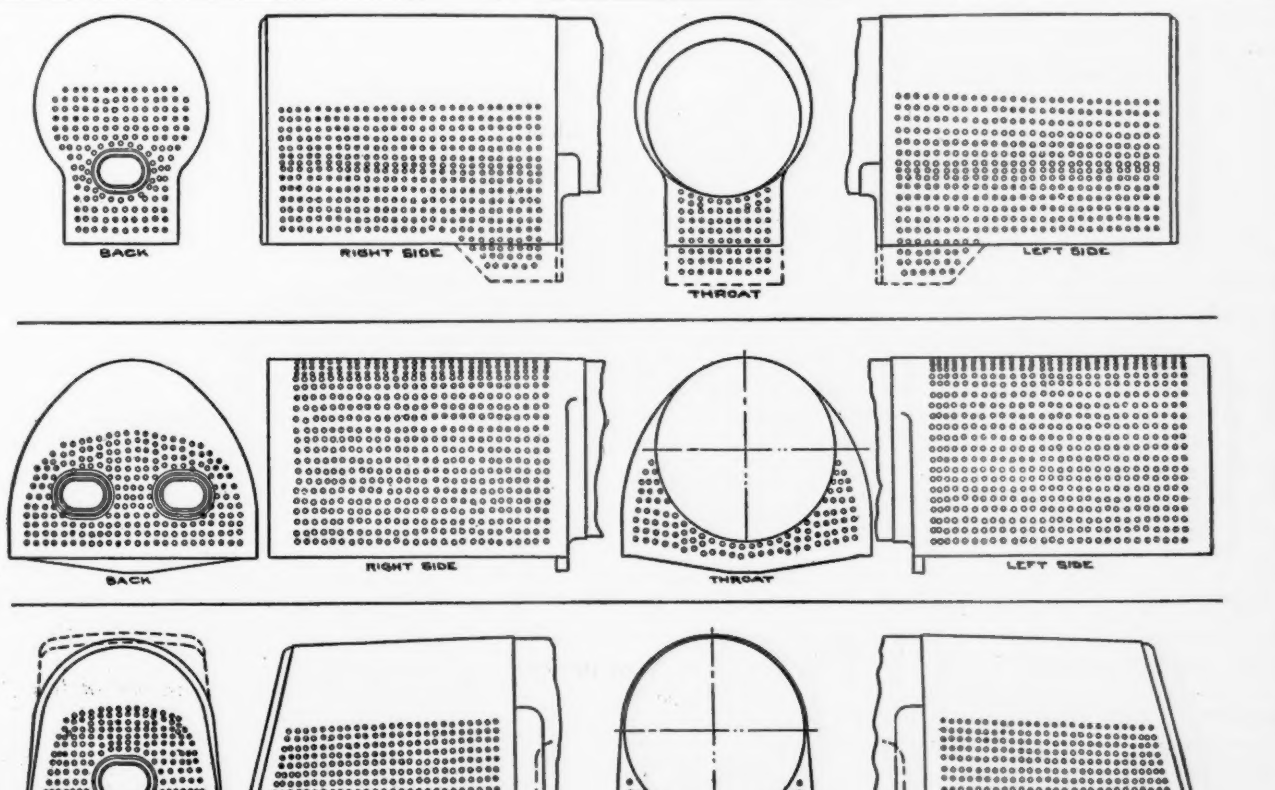
Condition of right side sheet ....Condition of brick arch ....

Condition of left side sheet.......................................Condition of boiler with respect to washing out (See Instructions) ....

Memoranda: ....

Boiler tested with .... lbs. water pressure..................Safety valves set at ... lbs.......................

Working pressure .... lbs.................................Authorized working pressure .... lbs......................



HEREBY CERTIFY THE ABOVE REPORT TO BE CORRECT AND THE RESULT OF MY EXAMINATION

______________________ INSPECTOR

CORRECT______________________ BOILER MAKER FOREMAN

______________________ GENERAL FOREMAN OR MASTER MECHANIC

______________________ SUPT. MOTIVE POWER

Fig. 4—Form for Report of Staybolt Test and Firebox Inspection.

location of each broken bolt, marking it on the form shown in Fig. 4, and must forward it to the master mechanic or foreman in charge. Master mechanics must promptly report dates of all staybolt tests.

WASHING AND BLOWING OUT OF WATER GAGES.

The boiler inspector must see that the water gage is washed and cleaned at each boiler washing. This should be done before reducing the boiler pressure, by opening the drain cock in the bottom of the gage and allowing first the water and then the steam to blow. As a general rule this will accomplish the cleaning of the gage, but to insure a perfect condition of the gage, after the steam and water pressure has been reduced the drain cock, water and steam valves should be removed and a wire run through the openings. This can be done without disturbing the glass.

After the cleaning of the boiler and when pressure is again applied the water gage should have the drain cock opened, and the water and steam should be allowed to blow through the fittings to note if gage is thoroughly cleaned. Master mechanics and road foremen should insist on the engineers blowing out the gage at the beginning of each trip. All water glasses should be supplied with two valves or shut off cocks, one at the upper and one at the lower connection to the boiler, also a drain cock. It should be so constructed and located that they can be easily opened and closed by hand. The spindles of all gage cocks should be removed and the cocks thoroughly cleaned of scale and sediment at least once every month. All gage cocks must be tested before each trip and must be maintained in such condition that they can be easily opened and closed by hand without the aid of a wrench or other tool.

SETTING OF SAFETY VALVES.

Safety valves should be set by the gage used on the boiler to pop at pressures not exceeding 6 lbs. above the allowed steam pressure, the gage in all cases to be tested before the safety valves are set or any changes are made in the setting. When setting safety valves the water level in the boiler must not be above the highest gage cock. Safety valves should be tested under steam at least once very three months, and also when any irregularity is reported.

RESPONSIBILITY FOR BOILERS.

It must be understood that the above rules apply to all locomotive boilers, whether in freight or passenger service, and that they are in direct charge of the master mechanic in whose district they may be placed.

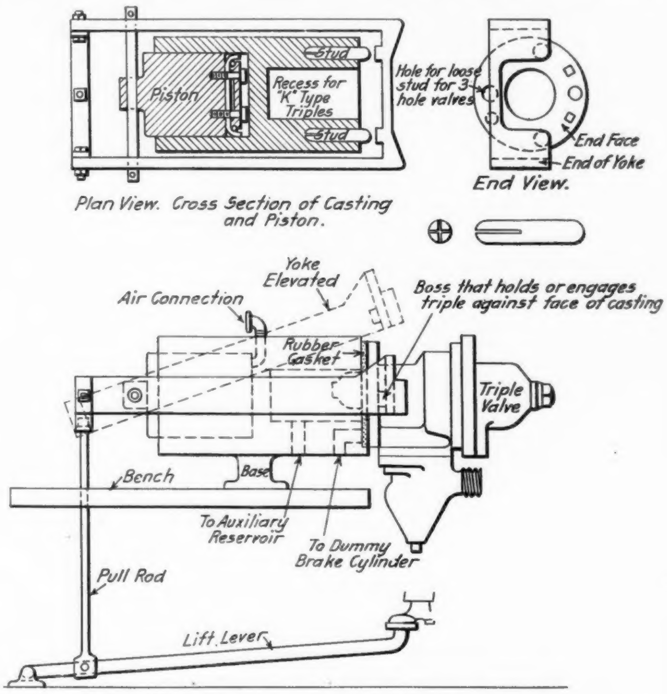
Locomotive boilers must be tested and inspected in conformity with the requirements of the law. Where no laws exist, the above rules must be adhered to. Where laws do exist, but do not require tests as rigid as the above, the necessary additional tests must be made to conform both to the law and to these rules.

The mechanical department can tell from the report of the staybolt test and firebox inspection whether any chronic weaknesses develop in the boilers, and can remedy them by strengthening the sheets or applying flexible stays in place of common ones.

Preventing Slipped Eccentric Blades.—On the Chicago & North Western, it is the practice to fit babbitt blocks in the slotted opening of the eccentric strap on either side of the bolts that hold the blade. These blocks are the proper shape to fit around the bolt and to fill in the slotted opening. Various sizes are kept in stock, and after the valves are set the nuts are taken off and these blocks are fitted on either side of the bolt. The nut is then replaced and tightened. In this way there is no danger of a slipped blade, if the nuts become loosened.

PNEUMATIC CLAMP FOR TESTING TRIPLE VALVES

A simple device for holding a triple valve while undergoing test, after being cleaned or repaired, is shown in the accompanying illustrations. It was designed by J. A. Jesson, Louisville & Nashville, Corbin, Ky., and consists simply of a casting 7 in. in diameter and 10 in. long, which includes a base for attaching it to a bench. One end is faced off and recessed for receiving the triple valve and will accommodate all types of quick action valves A separate plate is necessary when testing plain triple valves. At the opposite end the casting is bored out to a diameter of 4 in. x 6 in. depth, and a large solid piston with leather packing is inserted. A hole is drilled through the casting to this opening and a connection is made to the air supply. Passages are also drilled to the recess at the opposite end for connection to the auxiliary reservoir and to the dummy brake cylinder. A boss on the end of the piston has a hole through which a rod is passed that supports a yoke surrounding the whole casting. At the end where the valve is attached this yoke is arched to clear the triple valve flange



Clamp for Holding a Triple Valve When Testing.

and body, and is provided with bosses arranged as is shown in the illustration. At the back end of the yoke is a cross connection and a bar reaches to a foot treadle allowing the forward end of the yoke to be raised up by foot pressure. The open position is shown by the dotted lines. There are two or three loose pins fitted at the proper point for keeping the valve in place.

With the foot on the treadle the yoke is raised so that the valve can be slipped in place, after which the foot pressure is released and the yoke falls in position. The air is turned on and the valve is clamped securely against the leather gasket where it is held during the testing operation. When the air is discharged from the piston a slight downward pressure on the triple valve loosens the yoke and permits it to be raised up with the foot treadle.

New York Subways—A resolution has been approved by the New York State Public Service Commission for the construction of a moving platform subway in Thirty-fourth street. It will extend from Third to a little beyond Eighth avenue.

PISTON, PISTON ROD AND CROSSHEAD REPAIRS

Methods Employed in Two Different Shops. Submitted in the Competition That Closed September 1.

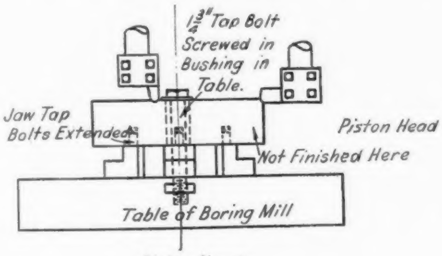
FIRST PRIZE

BY G. H. ROBERTS,
Machine Foreman, Long Island Railroad, Richmond Hill, N. Y.

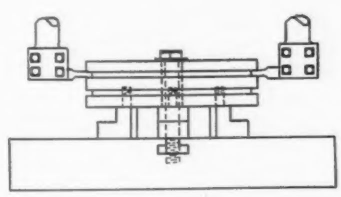
The writer was fortunate enough to have the opportunity to put in effect some original and possibly radical ideas in handling the machine and fitting work in one of the largest railway shops in this country,and was able to make a large saving in the cost of the repairs on pistons, rods, etc., besides bringing the work up to such a standard that necessary work was finished and ready for engines before they were due out of shop instead of old material in an inferior condition being reapplied to engines.

In a shop turning out two locomotives a day, four new piston heads and rods a day are required as a rule. This is enough to keep a boring mill working on pistons continuously and two or three lathes on rods.

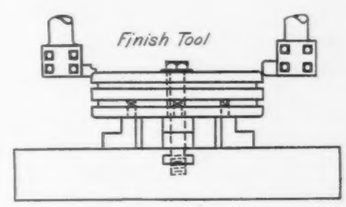
The following methods were put in effect on the piston and crosshead job and in a remarkably short time the pistons and crossheads were in the lead where formerly they brought up the rear. One vertical boring mill turned all the piston heads, besides doing part of the cylinder head work; two lathes more than kept up the rods and had considerable time for other work, where formerly two and sometimes three lathes were on piston rods.



Piston Heads
Operation No. 1.

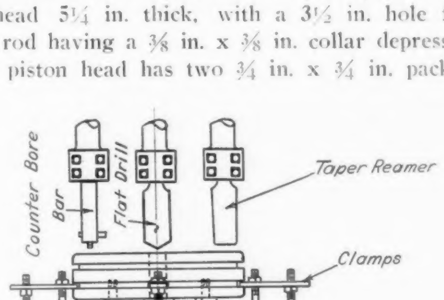


Piston Heads
Operation No. 2.



Piston Heads
Operation No. 3.

One of the illustrations shows the first operation on a 21 in. piston head 5¼ in. thick, with a 3½ in. hole for piston rod fit, the rod having a ⅜ in. x ⅜ in. collar depressed in the head. The piston head has two ¾ in. x ¾ in. packing rings and six holes in the front face to allow for core removal. By setting the head on top of the chuck jaws and extending the jaw tap bolts up in three of the core holes a unique method of holding the head was obtained, allowing the whole wearing surface to be finished in one setting, besides finishing the hole for the rod. The head is held down by a 1¾ in. bolt through the cored hole for the rod and screwed in a tapped bushing applied to the center of the boring mill table from the under side. The bushing has a shoulder to keep it from being pulled through the hole. The heads are not finished on the front face. The bearing for the nut is faced off when the head is on the rod just before the nut is applied.



Piston Heads.
Operations Nos. 4, 5 & 6.

Operation No. 1 is accomplished as follows:

Set up	20 min.
Rough face and top	15 "
Total	35 "

The speed is 35 ft. per minute, and the feed on the face is ⅛ in. and ¼ in. on the top. The cut on the face is from ¼ in. to ½ in. deep and about ⅛ in. on the top.

Operation No. 2 consists of cutting the grooves for the packing rings. Two tools are used, one ½ in. wide on the left side to rough out the groove and one ¾ in. wide on the right side to finish the groove. A 1/64 in. feed is used at 35 ft. per minute cutting speed. The time for two grooves is 25 minutes.

On operation No. 3 of finishing the outside to fit the cylinder, a broad tool is used with ¼ in. feed at 35 ft. per minute. This cut requires 15 minutes. The corners are rounded off while the cut is running down by using a fillet tool in the other head.

Operations 4, 5 and 6 are shown in one illustration. Three clamps are applied to the outside of the head and the bolt in the center is removed, allowing the hole to be finished. This requires about 5 minutes. The operation of finishing the rod fit requires the following times:

Drill	10 min.
Ream hole to plug gage	10 "
Counterbore for collar	5 "
Remove from machine	7 "
Total	32 "

The boring mill hand is furnished the proper size to turn the piston by the machine shop inspector, who inspected all the work This saves at least 15 minutes that is ordinarily used by the machine hand to locate the engine and caliper the cylinders himself.

After the piston head is turned the cored holes in the face are drilled and tapped on a radial dress for a 1¼ in. socket pipe plug. The drill press hand also applies the plugs, using a square ended wrench 15 in. long. The time required to drill, tap and apply 6 plugs is 40 minutes. A 1½ in. high speed drill is used on the cored holes. The plugs are screwed about 1/16 in. below the face of the head and the edge is hammered over so that the plug cannot work out.

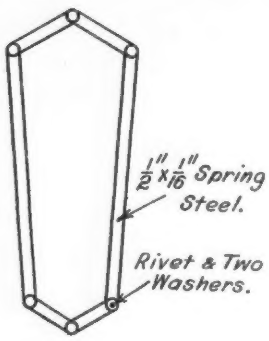
The plug and bushing gages used on the piston rods and heads are illustrated.

PISTON RODS.

The piston rods are taken in the rough and cut to length and centered in a 6 in. bore Gisholt lathe, requiring from 20 to 30 minutes to complete one rod. It takes at least twice as long

to do this in an engine lathe, where one compromise forging is used for various lengths and diameters of rods. The rods are then delivered to the engine lathe to be rough turned and fitted to the crosshead. This operation requires two hours at 45 ft. speed and 1/32 in. feed.

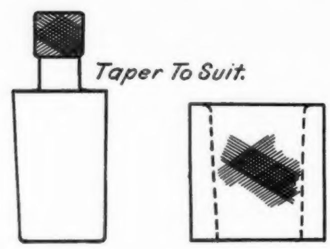
The keyway is scribed by the lathe hand and the rod is passed



Adjustable Gage for Getting Size & Taper of Piston Rod Keys.

on to the keyway cutting machine, where 45 minutes is required to cut a 5/8 in. keyway in a 3½ in. rod and one hour for a ¾ in. keyway in a 4 in. rod. The keyway cutting machine rigged up with an adjustable head for setting the scribed lines to the cutters is shown in one of the illustrations. The advantage of this head is plainly shown when a rod is to be applied to a crosshead where care has not been exercised in laying off the keyway in the crosshead central with the hole for the rod. Double end cutters are used which are made of high speed steel.

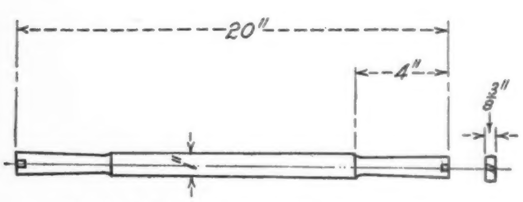
After the keyway is cut the bench hand takes the rod and applies it to the crosshead to have the key fitted. The adjustable gage to get the size and taper of the key quickly is shown, which saves about 10 minutes over the old method of laying off the key. The piston rod keys are made of spring steel, annealed, and are purchased in bars and nicked and broken off to the required lengths by the blacksmith. The steel is purchased in the required thicknesses and does not require planing on the sides. The edges are shaped to lines scribed from the adjustable gage. These keys require from 30 to 45 minutes to plane to fit. The variation in time is due to the different widths of keys. After



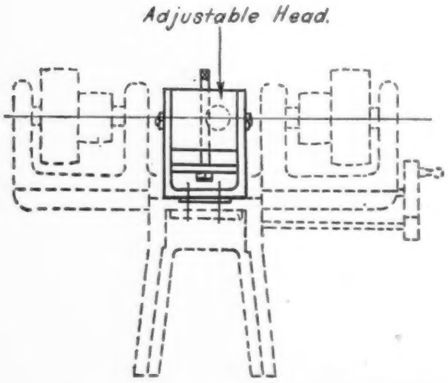
Plug & Bushing For Piston Rod & Head Fits.

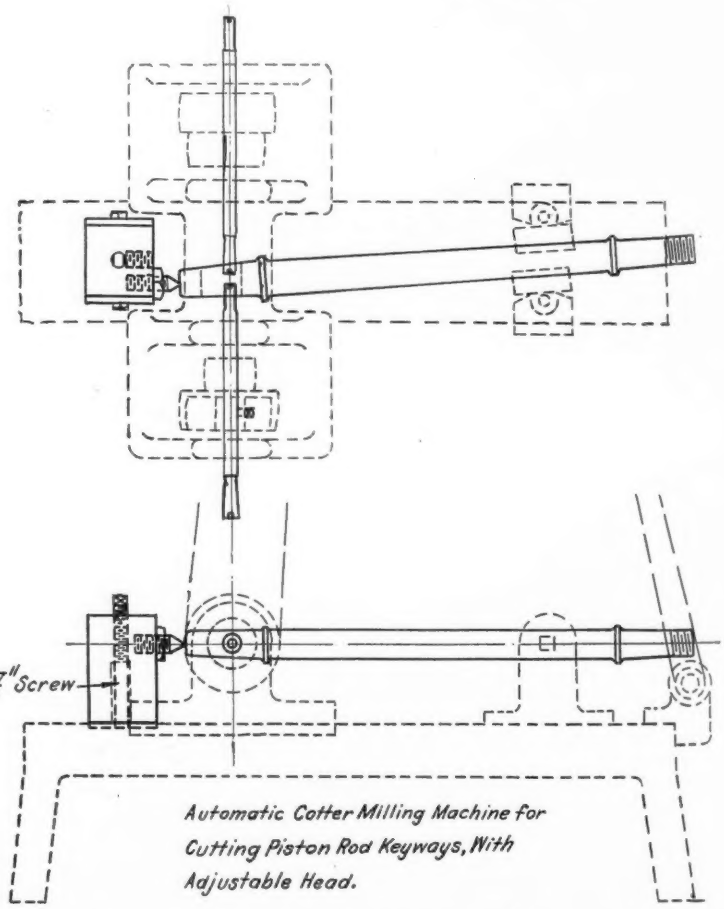
the key is shaped the bench hand dresses the ends on an emery wheel, requiring from 8 to 10 minutes per key. They are then drilled for the cotter pin and stamped.

After the key is fitted, the rod is passed to a second lathe where it is turned to fit the bushing gage and the thread is cut. This requires 45 minutes at 60 ft. cutting speed, 1/16 in. roughing and transferred to the 1/64 in. finishing feed.



Double Ended Cutters Used. Made of High Speed Steel.





Automatic Cotter Milling Machine for Cutting Piston Rod Keyways, With Adjustable Head.

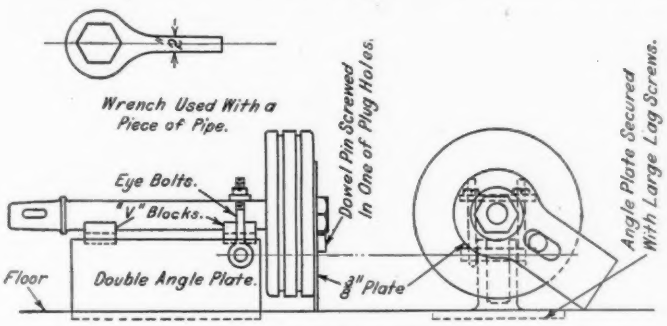
The rod is then transferred to the grinder. Grinding requires from 20 to 30 minutes.

Considerable trouble has been experienced on several railways with the piston heads getting loose on the rod. By allowing 3/16 in. for the rods to be drawn in the head, tightening up the nut and then hitting the rod with a sledge, this trouble can be avoided. An apparatus that has been made to hold the

rod and head in position to use a large wrench to tighten the nuts securely is illustrated. After this was installed all trouble with loose heads ceased. The time required with two men is from 15 to 20 minutes. With this method no twisting strain is placed on the piston rod.

PISTON PACKING RINGS.

In operation No. 1 of making piston packing rings on a 36 in.



Piston Heads.
Tighting Head On Rod.

or 42 in. vertical boring mill both heads are used. The time required is as follows.

Set up the casting	25 min.
Roughing out inside and out	90 "
Finish outside	30 "
Total	145 "

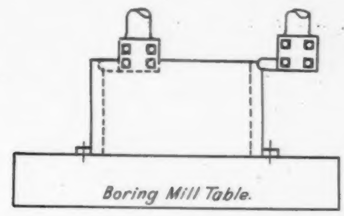
The cutting speed is 40 ft. per minute, the feed 3/32 in. and the cut from ¼ in. to ½ in. deep.

In operation No. 2—cutting off the rings with a gang tool—the corners are rounded off with a hand tool after the ring is partly cut off. The tools in the gang tool are set ahead of each other so each ring can be faced to exact thickness with a tool in the other head. The time required is as follows:

Grind and set gang tool	20 min.
Cut off 12 rings ¾ in. wide	90 "
Total	110 "

The cutting speed is 35 ft. per minute and the feed is 1/64 in.

spring and are cut out square across for the dowels. A piece 1⅛ in. thick is cut out of the rings with a handle chisel and sledge, requiring about half a minute a ring for a machinist

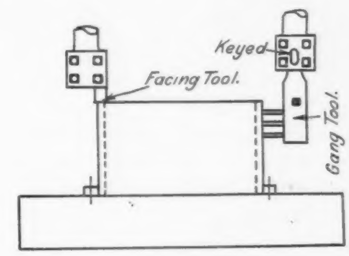


Piston Packing Rings.
Operation Nº1.

and helper. The rings are then dressed on the edges with a file and tried in the cylinder.

CROSSHEAD.

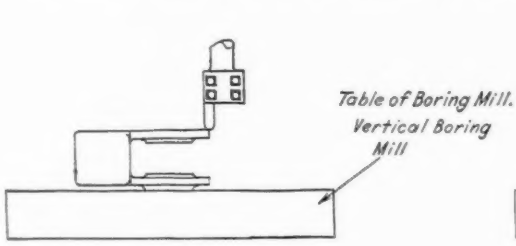
Operation No. 1 on a new 16 in. standard type crosshead with detachable shoes is performed on a 42 in. vertical boring mill.



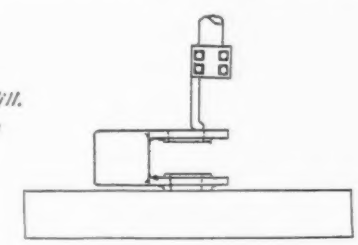
Piston Packing Rings.
Operation Nº2.

The crosshead is laid out and the back face is faced off, requiring one hour to lay out and set up and 30 minutes to rough and finish the face. A cutting speed of 45 ft. per minute and a ⅛ in. feed are used.

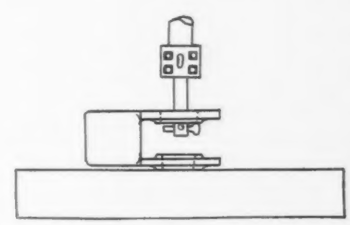
Operation No. 2 requires 30 min. to drill the hole and 30 minutes to bore it taper. It is fitted to the plug gage.



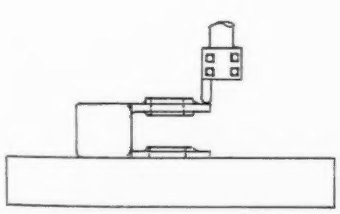
Crosshead - New.
Operation Nº1.



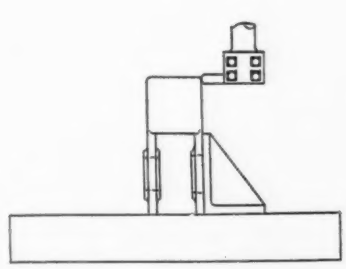
Crosshead - New.
Operation Nº2.



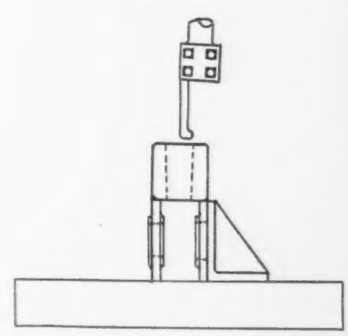
Crosshead - New.
Operation Nº3



Crosshead - New.
Operating Nº4.



Crosshead - New.
Operation Nº5.



Crosshead - New.
Operation Nº6

The piston heads have two ⅜ in. dowel pins at the bottom of the groove to keep the rings from shifting. The rings are turned ¼ in. larger than the diameter of the cylinders for

Operation No. 3 consists of facing the inside faces and requires 40 minutes.

Operation No. 4 of turning the boss on the outside requires

20 minutes to reset and 30 minutes to turn the boss and face it.

Operation No. 5 requires 30 minutes to reset and 45 minutes to rough and finish the shank.

The next operation consists of boring the hole and reaming to the plug gage, requiring 1½ hours.

The crosshead is now ready for planing on the flanges for the shoes, using a mandrel and V block on the bed of a planer. This operation requires 1½ hours. A broad tool is used which makes it necessary to feed down but twice on each shoe, as the tool is wider than half the width of the guide.

The piston rod and wrist pin holes frequently require reaming, but in a great many shops very little of this work in done. Inserted tooth reamers of high speed steel were made for this job and all holes are cleaned up that show any sign that the old rod or pin were loose; 25 to 35 minutes are required to ream either hole.

The crosshead shoes are cast steel with a babbitt lining of ⅛ in. thickness. The shoes are spotted with the point of the drill to help hold the babbitt. The shoe is then heated and tinned. After this is done the shoe is set on end and a wooden former is clamped to it, using fire clay at the bottom to stop the babbitt from running out. After the shoes are babitted they are applied to the crosshead and if the bolt holes are not true they are reamed out and new bolts applied.

A recapitulation of the times given shows the total operation to require 16 hours 43 minutes, being subdivided as follows:

Finishing new piston head	152 min.
Completing the rod and putting on head	334 "
Finishing two packing rings	22 "
Finishing a new crosshead	495 "

CENTRAL OF GEORGIA PRACTICE

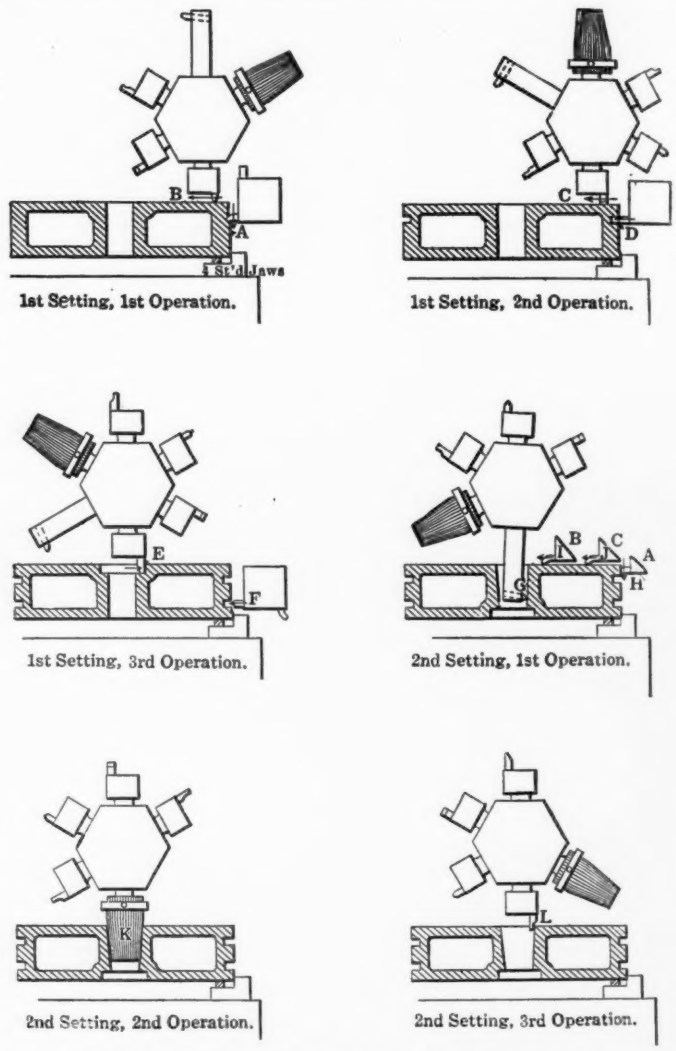
BY C. L. DICKERT
Assistant Master Mechanic, Central of Georgia, Macon, Ga.

Removing the piston from a locomotive, which includes the removal of the casing, front cylinder head, cutting loose from the crosshead, removing rod packing and putting the piston and rod on the floor, requires on an average of twenty-five minutes The time of this operation, of course, will vary largely, depending on the difficulty that is found in separating the rod and the cross head. The above time is a fair average.

PISTON HEAD.

Piston heads are finished on a 36 in. Bullard vertical turret lathe in an average time of 81⅔ minutes, which includes facing, boring, turning and grooving. This operation, on a test, has been completed in 64½ minutes, the detail time being shown in the accompanying table. The illustration shows the various operations so clearly that no explanation is required. The time of 81⅔ minutes is the average for a day's work.

After the head is removed from the vertical turret lathe, the seven core holes are reamed and tapped on a 6-foot radial drill. This operation requires 11 minutes. Making the seven plugs on a 2 in. x 24 in. turret lathe require 14 minutes and screwing them in the head and riveting them over takes 7 minutes. These plugs are made from the proper size iron and only requiring nicking, threading and cutting off. They are



Finishing a Piston Head on a Vertical Turret Lathe.

manufactured in quantities, being threaded with an automatic die head, and are placed in stock and issued as needed.

The complete operation of finishing the piston head thus requires 113⅔ minutes.

PISTON ROD.

The standard piston rod is shown in one of the illustrations. The material is Cambria steel, old car axles being used. Cut-

Operations and Time Required for Machining a 21¼ in. Piston on a 36 in. Vertical Turret Lathe.

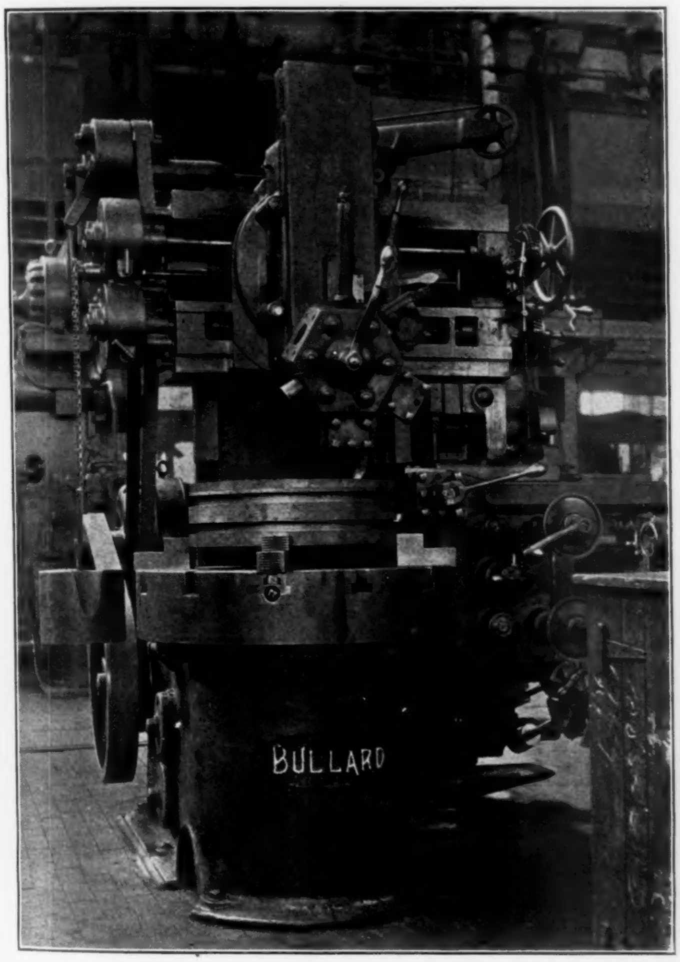
	Item.	Surface Machined.	Operations.	Depth of Cut	Feed Per Rev.	Rev. Per Min.	Minutes Each Operation	Minutes Required Actual
Setting No. 1.	1	....	Chuck work	....	....	....	4	4
	2	A	One tool, 6½ in. length of cut } Simultaneous Cuts...	⅛ in.	1/12	6	6½	....
	3	B	One tool, 9 in. length of cut } Simultaneous Cuts...	⅛ in.	1/12	6	9½	9½
	4	C	One tool, 9 in. length of cut } Simultaneous Cuts...	1/64 in.	1/3	6	2½	.....
	5	D	One tool, 1 in. x 1 in. groove }	....	1/96	6	11	11
	6	E	One tool, ¾ in. x 2 in. cut	¾ in.	1/24	6	3	....
	7	F	One tool, 1 in. x 1 in. groove	....	1/96	6	11	11
	8	....	Remove piston	....	....	....	2	2
Setting No. 2	9	....	Chuck work	....	....	....	4½	4½
	10	G	Set tool and finish } Speed up to 34 rev. after H, I and J are finished. These operations performed while boring G	5/16 in.	1/12	6	20	....
	11	H	Set tool and finish	⅛ in.	1/12	6	1	20
	12	I	Set tool and finish	⅛ in.	1/12	6	8	....
	13	J	Set tool and finish	1/64 in.	1/3	6 &20	1¼	....
	14	K	Ream	....	....	....	2	2
	15	L	Fillet	....	....	....	½	½
						TOTAL....	86¾	64½

Piston in rough, 21¼ in. x 7 in., weight, 410 lbs.
Piston when finished, 21 in. x 6¾ in., weight, 337 lbs.
Metal removed, 73 lbs.
Kind of metal, Hunt-Spiller metal. Time consumed in machining six pistons, from floor to floor was 8 hours and 10 minutes, including oiling machine, grinding and setting tools and absence from machine that occurs during day's work. Average per piston, 81 2/3 minutes.

ting off to the proper length and annealing in the blacksmith shop requires 25 minutes for one rod. This is much longer than the average would be if the cutting off and annealing were done in quantities as is the usual practice. After being cut to length the pieces are transferred to the machine shop on industrial cars and are placed on a drill press for centering. The machine used is a small radial and this operation requires 5 minutes per rod. A jib crane serves the drill and also the 26 in. motor driven heavy duty lathe which is used for roughing. The roughing operation is performed at a speed of 49.55 ft. per minute and with a feed of 1/6 in., the average stock removed being 61/64 in. This operation requires 47 minutes, divided as follows:

Put in machine and adjust tools	5 min.
Facing ends	20 min.
Roughing (2 cuts)	20 min.
Removing from lathe	2 min.
Total	47 min.

The same crane transfers the rods from the roughing lathe to a rack back of the finishing lathe, which is arranged to hold



Finishing a Piston Head at the Macon Shops.

12 rods. The finishing lathe is a 24 in. motor driven machine and here the rod is finished for the crosshead and piston fits; the threads are turned, and the body of the rod is sized to within 1/64 in. These operations require 94 minutes, the detail time being as follows:

Finishing diameters A. & B. 1/64 in. above size	10 min.
Finishing piston fit	30 min.
Finishing crosshead fit	30 min.
Threading piston end	12 min.
Threading crosshead end	12 min.
Total	94 min.

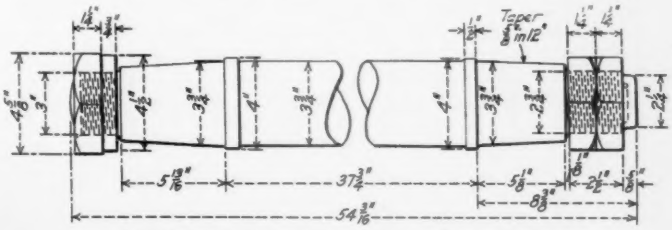
The rod is then transferred to the press just behind the finishing lathe where the head is pressed on and the nut applied. This press is converted from an old crank pin press and is admirably suited to the work. This operation requires 10 minutes.

After the head is pressed on, the rod is transferred to the grinder, where the 1/64 in. remaining stock is removed. The time required for this operation is 12 minutes, of which 2 is used in chucking the rod and adjusting the machine.

The whole operation of finishing the rod and applying the head thus requires 193 minutes.

PISTON PACKING.

A stock of packing drums is maintained on a platform under a gantry crane just outside the machine shop and the rings are manufactured for stock. The crane is provided with a magnet

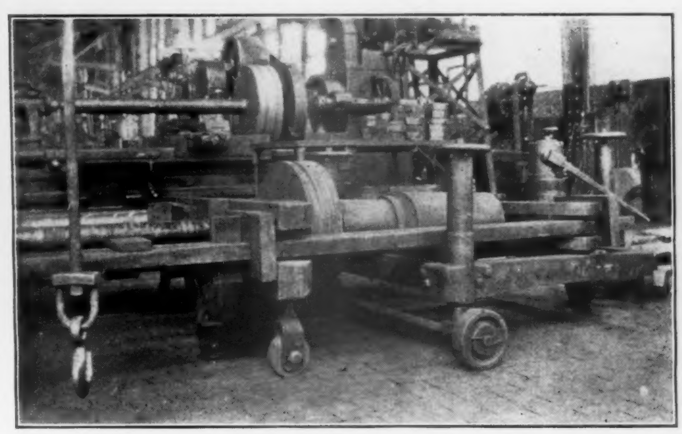


Standard Piston Rod.—Central of Georgia.

and the drums are loaded on an industrial car and transferred to the boring mill. After being finished to standard size they are delivered to the store room and issued on order. When rings are needed a messenger gets them from the stock and delivers them to the proper section of the shop, where they are cut and fitted to the head.

The drums are made in sufficient length to cut from 15 to 18 rings and from 38 to 54 rings will be completed in nine hours, the number depending on the ring size and the amount of stock to be removed. The mill has two heads, one used for boring and the other for turning, the two operations being performed at the same time. From ¼ to ½ in. of stock is removed by both tools. The rings are cut off with a six cutter gang tool,* which brings them to exact size without further machining. Each ring has two water grooves which are made with the other head while the gang tool is cutting off the rings. The average time for turning, boring, and cutting off two rings is 24 minutes. This is the average on the basis of several days' output.

The rings are cut to suit the size of the cylinders on a specially



Crank Pin Press Arranged for Forcing on Pistons.

designed packing ring saw which has two adjustable blades.† A ring can be cut in less than a minute at any desired angle and fits perfectly when closed in the cylinder. It will then require three minutes to apply the two rings to the head. The time for finishing and applying the piston rings totals 29 minutes.

CROSSHEADS.

Removing the crossheads from the engine will require 17 minutes. The old tin is then melted off with an oil burner.

*See *American Engineer and Railroad Journal*, April, 1911, page 131.
†See *American Engineer and Railroad Journal*, February, 1911, page 59.

Molds are placed on the head and new metal is poured in before the body has an opportunity to cool. The metal is heated on an oil burner forge. The complete operation requires 34 minutes. The crossheads are then placed on a 26 in. shaper, being clamped to the side of the table, and planed to size. The chucking and planing, complete, consumes 37 minutes.

The complete operation of repairing the crosshead where no work except the bearings on the guide is performed thus requires 88 minutes.

Applying the crosshead to the locomotive and lining the guides ready to apply the piston and rod will take on the average about 150 minutes.

Placing the piston in the cylinder, coupling up to the crosshead, putting on the front cylinder head and casing and getting new striking points takes 150 minutes.

Cutting Packing Rings With a Gang Tool.

The total time for the whole operation, including lining up the guides, is thus 739 minutes or practically 12½ hours, being divided as follows:

Removing piston from locomotive	25 min.
Completing piston head	114 min.
Completing rod and pressing on head	193 min.
Finishing and applying two packing rings	29 min.
Finishing repairs to crosshead	88 min.
Applying crosshead and lining guides	150 min.
Applying piston, putting on cylinder head, casing, etc.	150 min.
Total	749 min.

TRIPLEX COMPOUND LOCOMOTIVE

The weight of the loaded tender of Mallet locomotives is usually 40 to 50 per cent. of that of the engine ready for service. Some of these loaded tenders with four-wheel trucks weigh 175,000 to 180,000 lbs., and those with six-wheel trucks as much as 230,000 lbs. This has suggested the idea that the weight of tenders, when only 25 per cent. of the load of coal and water remains, would be sufficient for the adhesion required by a pair of large compound cylinders. The weight of the tender with 25 per cent. load would be over 100,000 lbs., which furnishes a sufficient load for a tractive effort of 25,000 lbs., and the weight of the locomotive running gear and machinery adds enough for the desired tractive effort.

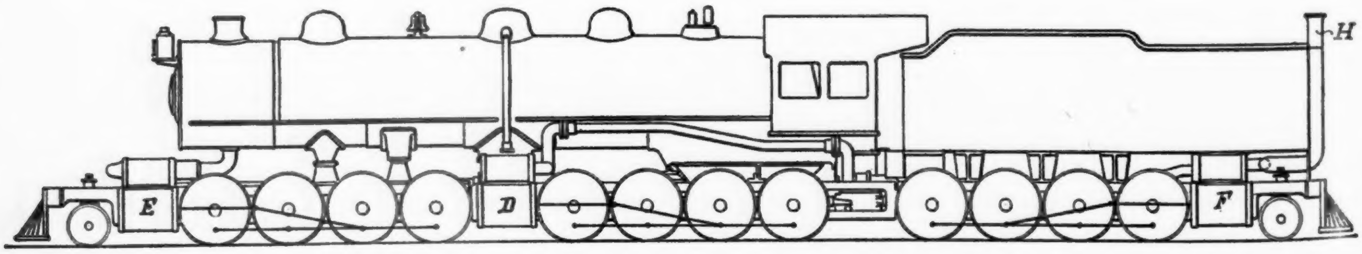
An interesting and ingenious design which is based on this principle is illustrated herewith. The engine is practically an ordinary Mallet with a working tender, but, instead of having the high and low pressure cylinders of different sizes, the locomotive is constructed with a pair of high pressure cylinders attached to the frames connected with the back part of the boiler and two pairs of low pressure cylinders, one of them being at the rear end of the tender; all the cylinders are of the same size, so that a compounding ratio of two to one is obtained. For instance, if the boiler carries 200 lbs., there would be 100 lbs. back pressure in the high pressure cylinders. This would give a mean effective pressure of 100 lbs. per sq. in. in all of the cylinders with the reverse lever in the corner.

The horizontal pipe with a ball joint in the cylinder saddle, which takes the exhaust from the high pressure cylinders to the low pressure cylinders, has given practically no trouble in Mallets now in service, and this is simply duplicated in the rear of the new design by making a pocket with a ball joint in the foot plate and taking the exhaust steam from the high pressure cylinders back to this foot plate, as well as forward to the front cylinder. The reason the cylinders on the tender are placed at the rear end is in order to make a suitable length swivel pipe which has the ball joint in the foot plate and which is analogous to the receiver pipe connecting the high and low pressure cylinders at the front of the engine. This pipe would be entirely too short for good service if the cylinders were at the front end of the tender, and besides, it allows a truck at the end, so that the locomotive can be run in either direction with equal satisfaction.

This engine has been worked out from a Great Northern locomotive as a base, and it is found that with a slight increase in the weight and cost, and without any increase in length, there is obtained about 50 per cent. more tractive effort, the working tender being so arranged that with only 25 per cent. of fuel and water remaining there will be sufficient weight to give the full adhesion.

Since the cylinders are all the same size, the pistons, valves, crossheads, and even rods are the same throughout the engine. The link motions will be practically the same and the spring riggings are the same on the front and back sections. The driving boxes may be made alike and this, together with the fact that there is really nothing in the way of experiment in the separate elements of the design, should make it a desirable type for heavy grade work. It is intended to take the exhaust from the rear section and pass it to the atmosphere by a separate pipe, or, if desired, it can be used for heating the water in the tender in cold weather. The special features of this design have been patented by George R. Henderson, and assigned to the Baldwin Locomotive Works.

Railway Capitalization.—The Interstate Commerce Commission in its twenty-fourth annual statistical report states that on June 30, 1911, the par value of the amount of railway capital outstanding was $19,208,935,081, which includes the capital held by the railway companies as well as by the public.



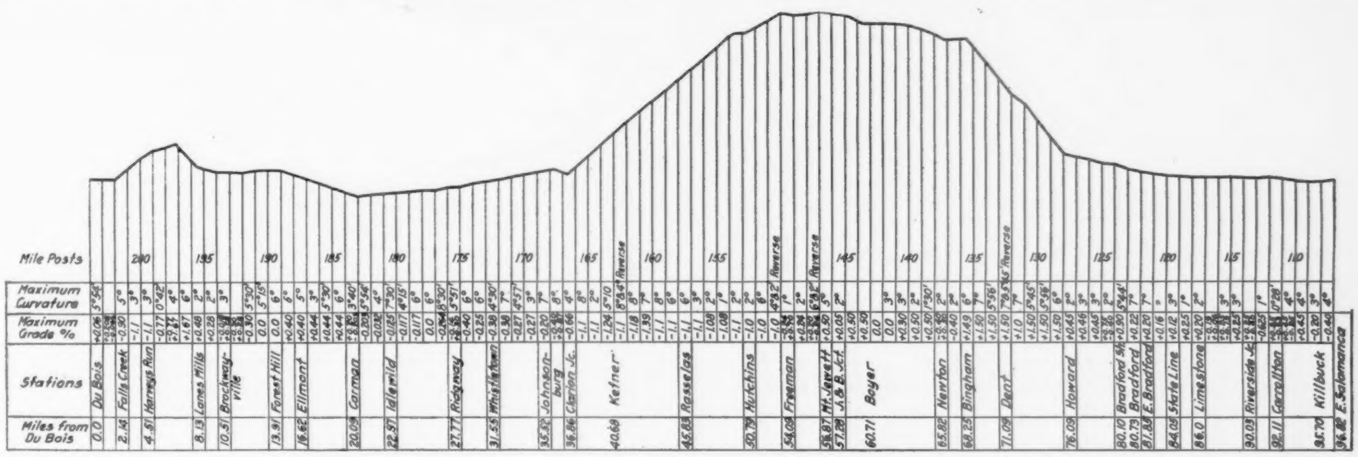
Proposed Triplex Compound Locomotive with Engine and Tender.

COMPARATIVE SERVICE TESTS OF LOCOMOTIVES

Road Trials on the B., R. & P. to Determine the Efficiency of the Superheater and Brick Arch.

The Buffalo, Rochester & Pittsburgh has a locomotive of the 2-8-2 type fitted with the latest design of Street automatic stoker, which includes a conveyor in the tender. The same road has also applied at its Du Bois, Pa., shops, superheaters of the top header type, as well as Security brick arches to several locomotives of the 4-4-2 type, as well as to some of the 2-8-0 type. In addition, a recent order of Pacific type locomotives was fitted with superheaters and brick arches by the builders. It was thus in position to make comparative trials in road service of a 2-8-2 type locomotive stoker fired and hand fired, of both an Atlantic type and a consolidation locomotive without superheater or brick arch in comparison with identical locomotives fitted with both of these devices, as well as of Pacific type locomotives originally designed to include superheater and brick arch. Such tests were made during the month of June with results which are given below.

In making the tests every precaution was taken to insure accuracy in connection with the coal and water consumption, weight of train, time, speed and distance. The coal was put up in 100 lb. sacks and the tank was fitted with gage glasses at diagonally opposite the corners and was accurately calibrated previous to the tests. A Hausshalter speed, time and distance indicator was installed in a special car which was included in each of the trains.



Profile of That Part of the Buffalo, Rochester & Pittsburgh on Which Locomotive Tests Were Made.

The trains were operated between Du Bois and Salamanca, a distance of 96.82 miles. The profile of this section of the road is shown in the accompanying illustration.

STOKER TESTS.

In the tests with the stoker locomotive it was found that the machine would develop the full power of the locomotive and that its operation was reliable. In as much as the fuel furnished the stoker was of a quality which could not be fired by hand while the coal on the hand fired test was an excellent grade of run of mine, the coal consumption either total or per ton-mile is not comparable. The stoker locomotive handled the same tonnage at about the same speed as the hand fired engine, and when a mixture of slack and nut was used there was no trouble in keeping the fire in good condition. On one run a very fine slack coal was put on the tender, and with this, considerable raking and some firing by hand were required. As might naturally be expected there was a slight increase in consumption of fuel by the stoker under these conditions.

SUPERHEATER AND BRICK ARCH TESTS.

There were three separate series of tests of the superheater and brick arch, two being comparative. The first series were on three Pacific type locomotives built by the American Locomotive Company,* which have the following general dimensions:

Total weight	258,000 lbs.
Weight on drivers	163,500 lbs.
Tractive effort	36,340 lbs.
Cylinders	24½ in. x 26 in.
Diameter of drivers	73 in.
Steam pressure	200 lbs.
Diameter of boiler	74 in.
Number and diameter of tubes	240—2 in.
Number and diameter of flues	32—5⅜ in.
Length of tubes	20 ft.
Heating surface, firebox	234 sq. ft.
Heating surface, tubes	3,391 sq. ft.
Heating surface, total evaporative	3,625 sq. ft.
Heating surface, superheater	757 sq. ft.
Grate area	56.5 sq. ft.

Of the four runs, two were made with one locomotive and one each with the other two. In each case a distance of 96.82 miles was covered. The train consisted of six cars of which four were coaches, one a cafe car, one baggage and one mail. The average weight of cars including passengers and lading was 286.5. The locomotive weighed 214 tons, giving an average weight of total train of 500 tons. The coal in each case was an excellent grade of run of mine and the weather and rail conditions were good. On two trips there were five slow orders on account of work on road and bridges, on another one there were six and another nine slow orders. The schedule provides two hours and forty-eight minutes for this train and on each run there were from seven to eleven minutes made up, there being eight stops in three cases and nine on the fourth run.

These stops consumed from thirteen to fifteen and one-half minutes on each trip. The average speed of the four trips, actual running time, was 42.6 miles per hour. In the following table is given the coal and water consumptions, averages of the four trips for the three locomotives.

Length of run	96.82 miles
Actual running time	2 hrs. 27 min.
Number stops	8.25
Number slow orders	6.25
Ton mileage, cars	27,739 tons
Ton mileage, total	48,458 tons
Lbs. of coal used, total	6,275 lbs.
Lbs. of coal per 100 ton-miles (includes weight of locomotive)	12.93
Lbs. of coal per 100 ton-mile (cars only)	22.55
Lbs. of coal per sq. ft. grate area per hr	41.38

*See *American Engineer*, May, 1912, page 251.

Lbs. of water used per hr.	19,410
Lbs. of water per lb. of coal	8.385
Lbs. of water per sq. ft. evaporative heating surface per hr.	5.35
Lbs. of water per 100 ton-miles (includes weight of locomotive)	107.53
Lbs. of water from and at 212 deg. per lb. of coal	10.14
Lbs. of water from and at 212 deg. per sq. ft. of heating surface per hr.	6.46

The speed curves show that speeds of 60 miles per hour were frequent for short distances.

Atlantic type locomotive No. 162 is of the same class as No. 163 and was fitted with a Security brick arch and Schmidt superheater at the Du Bois shops. There were no other changes made in the locomotive. The alteration in the heating surface is shown in the following table of dimensions:

	Saturated.	Superheated.
Total weight	173,000 lbs.	183,000 lbs.
Weight on drivers	99,000 lbs.	113,700 lbs.
Size of cylinders	20¼ in. x 26 in.	20¼ in. x 26 in.
Diameters of drivers	72 in.	72 in.
Steam pressure	200 lbs.	200 lbs.
Tractive effort	25,173 lbs.	25,173 lbs.
Diameter of boiler	70⅛ in.	70⅛ in.
Heating surface, firebox	194 sq. ft.	221.1 sq. ft.
Heating surface, tubes	2,798.4 sq. ft.	2,157.4 sq. ft.
Heating surface, total	2,992.4 sq. ft.	2,378.5 sq. ft.
Superheater units	....	26
Superheater heating surface	....	480 sq. ft.
Grate area	54.4 sq. ft.	54.4 sq. ft.

The train was practically the same as that used in the tests of the 4-6-2 type locomotive, and had an average weight of 288 tons, including passengers and lading, on the superheater tests and 289 tons on the saturated steam tests. The former locomotive weighed 189 tons as compared with 186 tons for the latter. The distance was 96.82 miles and the schedule allowed two hours and forty-eight minutes. The weather in each case was fair, wind light and rail good. On the first trip with the superheater locomotive there were ten slow orders in addition to nine stops and 4 min. 50 sec. were lost on the trip. On the second trip there were but five slow orders in addition to the nine stops and the run was made in three minutes less than schedule time. On the third trip, with the saturated steam engine, there were five slow orders and nine stops, and fifteen minutes were lost. On the fourth trip there were five slow orders and nine stops and three and a quarter minutes were lost. The coal in each case was an excellent grade of run of mine. The following table will permit a comparison of the coal and water consumption of the two locomotives. The percentage column is based on 100 per cent. for the superheater engine.

	Superheated.	Saturated.	Per Cent.
Length of run, miles	96.82	96.82	....
Actual running time, hrs	2.5	2.63	105.3
Number of stops	9	9	....
Number of slow orders	8	5	....
Ton mileage (cars only)	27,884	27,981	100.3
Ton mileage (including weight of locomotive)	42,504	42,117	99.1
Lbs. of coal used, total	6,350	7,300	115
Lbs. coal per 100 ton-miles (including weight of locomotive)	14.90	17.30	116.1
Lbs. of coal per sq. ft. of grate area per hr.	41.44	45.60	110
Lbs. of water, total	49,090	59,552	121.3
Lbs. of water used per hr	17,451	20,208	115.8
Lbs. of water per lb. of coal	7.74	8.16	105.5
Lbs. of water per sq. ft. evap. heating surface per hr	7.33	6.75	92.1
Lbs. water per 100 ton-miles (including weight of locomotive)	115.51	141.38	122.4
Lbs. of water from and at 212 deg. per hr.	21,168	24,481	115.7
Lbs. of water from and at 212 deg. per lb. of coal	9.38	9.88	105.3
Lbs. of water from and at 212 deg. per sq. ft. heat. surface per hr.	8.88	8.17	92

Four runs were made with two consolidation locomotives which were identical with the exception that one was fitted with superheater and brick arch which had been applied at the company's shops. These locomotives have the following dimensions:

	Saturated.	Superheated.
Total weight	184,000 lbs.	194,000 lbs.
Weight on drivers	164,000 lbs.	173,500 lbs.
Cylinders, diam. and stroke	21 in. x 28 in.	21 in. x 28 in.
Drivers, diameter	57 in.	57 in.
Steam pressure	200 lbs.	200 lbs.
Tractive effort	36,827 lbs.	36,827 lbs.
Diameter of boiler	70 in.	70 in.
Heating surface, firebox	190 sq. ft.	218.8 sq. ft.
Heating surface, tubes	2,672 sq. ft.	2,154.6 sq. ft.
Heating surface, total evap.	2,862 sq. ft.	2,373.4 sq. ft.
Heating surface, superheater	....	460 sq. ft.
Superheater, number units	....	28
Grate area	54.4 sq. ft.	54.4 sq. ft.

The same excellent quality of run of mine of coal was used in each of the four runs, all of which were hand fired. The weather and rail conditions were good and the same for each run. In each case a helper was used from Falls Creek to McMinns Summit, a distance of four miles. On the runs with the superheater locomotive this consisted of a consolidation locomotive with 21 in. x 28 in. cylinders, 57 in. drivers, and a tractive effort of 35,827 lbs. A larger helper was used on the saturated steam tests; it was a 22 in. x 28 in. consolidation with 56 in. drivers, 200 lbs. steam pressure, and a tractive effort of 41,140 lbs. A pusher engine was attached at Clarion Junction and helped the trains to Freeman, a distance of about 17¼ miles. This was a decapod with cylinders 24 in. x 28 in., 52 in. drivers, 200 lbs. steam pressure, and a tractive effort of 52,730 lbs. The same locomotive was used at the same places on each of the runs and no deduction is made for the work that either the helper or pusher did in handling the train, nor are their weights or coal consumption included in the results.

The average of the two trips with the superheater locomotive and the two trips with the saturated engine give the coal and water consumption shown in the following table. The per cent column is based on 100 per cent. for the superheater locomotive

	Superheated.	Saturated.	Per Cent.
Length of run (miles)	95	95	....
Actual running time (hrs.)	6.23	6.67	107
Number of stops	12.5	17.5	140
Ton mileage (cars only)	227,760	212,472	93.3
Ton mileage (includes weight of locomotive)	242,913	227,098	93.5
Lbs. of coal (total)	11,950	16,050	134
Lbs. of coal per 100 ton-miles of cars	5.25	7.5	142.9
Lbs. of coal per 100 ton-miles (includes weight of locomotive)	4.89	7	143.3
Lbs. coal per sq. ft. of grate area per hr.	24.93	31.29	125.5
Lbs. of water (total)	91,894	126,650	137.9
Lbs. of water per hr	10,432	13,446	128.9
Lbs. of water per lb. of coal	7.69	7.89	102.7
Lbs. of water per sq. ft. of evap. heating surface per hr	4.39	4.69	106.8
Lbs. of water per 100 ton-miles (includes weight of locomotive)	37.85	55.77	147.3
Lbs. of water from and at 212 deg. per lb. of coal	9.30	9.52	102.4
Lbs. of water from and at 212 deg. per sq. ft. evap. heating surface per hr.	5.31	5.65	106.5

The result of these tests very clearly shows the advantage of the superheater and brick arch for both passenger and freight service and the Buffalo, Rochester & Pittsburgh is now engaged in equipping other locomotives with these appliances as rapidly as possible.

MANUFACTURING IN THE UNITED STATES.—The Bureau of Statistics of the Department of Commerce and Labor has placed the total value of the manufactures for 1912, excluding foodstuffs exported, at $1,021,753,918. The value of the exports in 1912 is more than double that in 1903 and three times that of 1898. The principal articles in 1912 were iron, steel, copper, mineral oil, cotton manufactures, cars, coaches, automobiles and paper.

DEATH RATE IN AMERICAN COAL MINES.—The United States Bureau of Mines has issued a report which shows that 2,517 men were killed in the mines last year, as against the highest record of 3,197 in 1907. Dr. Joseph A. Holmes, director of the Bureau of Mines, states that although there has been a decreasing number of men killed for every million tons of coal mined since 1907, the United States is still far below the standard of safety it should reach. The bureau is co-operating with the mine operators, which will tend to improve the present conditions.

RAILWAY MASTER PAINTERS' ASSOCIATION

Reports Were Presented on Car Renovators, Treatment of Concrete Floors and Care of Steel Car Roofs.

The forty-third annual convention of the Master Car and Locomotive Painters' Association was held in Denver, Colo., September 10-13, 1912. J. T. McCracken, master painter of the Interborough Rapid Transit, New York, presided. The opening prayer was made by Dr. Elmer E. Higley, pastor of the Grace M. E. Church and the association was welcomed to the city by Henry J. Arnold, mayor of Denver. Chas. E. Copp, foreman painter of the Boston & Maine, Concord, N. H., responded to the mayor. J. F. Enright, superintendent of motive power and car department of the Denver & Rio Grande and President McCracken then made addresses.

MAINTENANCE OF STEEL CARS

J. T. McCracken (I. R. T., New York).—We have 500 steel cars, which have been in service about 8 years, and owing to their having been painted properly at the beginning, we have not found it necessary, as yet, to remove the old paint. Our actual cost of keeping these cars in this condition, based on a 14 months' schedule of shopping, is 18 cents per day.

F. M. Pribble (L. & A., Stamps, Ark.).—It pays to keep any class or style of structure well painted, especially steel cars, which yield so readily to the ravages of rust, and more especially when these cars are exposed to wide atmospheric changes, sometimes being moved from one place to another in the course of a few hours where climatic conditions, etc., are entirely different. Rust, once given a start, is tenacious and hard to handle and will spread in a surprising manner, eating its way back under a seemingly solid film of paint.

J. Spirk (C. R. I. & P., Davenport, Iowa).—Some of our steel gondolas were loaded with hot cinders, which burned off the paint and left the steel bare. The rust soon played havoc with these spots. I scraped them with a steel wire brush, washed with benzine, put on a good coat of paint, and I venture to say that, by that timely attention, a considerable expense was saved.

F. A. Weis (C. R. R. of N. J., Elizabeth, N. J.).—The approximate cost of sand blasting and painting an 80,000-lb. capacity steel coal car is $11, and the average life of the paint is 5 years. The original thickness of the metal sheets used for the sides of coal cars is 1/4 in., and if they are allowed to deteriorate to about 1/8 in., it will be necessary to replace them. The insides of these cars are not painted and deterioration is at about the rate of 5 ozs. per square foot of surface per year, due principally to the action of the weather and sulphurous acids due to decomposition of the lading. The exterior surface, if not painted, and if exposed to the weather, will deteriorate at about 3 ozs. per sq. ft. of surface each year. It is evident that, with these rates of deterioration, if the cars are not painted, the sheet will be reduced to about 1/8 in. in thickness at the end of ten years. If they are painted, it would be about 17 years before it would be necessary to replace the sheet. Thus at a cost of $44 for sandblasting and painting, it is possible to obtain seven years' more service.

REPORT OF TEST COMMITTEE

The test committee presented for the consideration of the members various test panels comparing turpentine substitutes with the pure turpentine, also of white pigments, high grade metal preservers and red lead, and a test of exterior body varnishes for passenger equipment. The turpentine test consisted of 8 substitutes and pure turpentine. The panels were exposed June 9, 1911, and examined June 1, 1912, with the results in favor of the pure turpentine. The eight samples really represented three general types of turpentine substitutes, viz., wood turpentine, petroleum spirits from a parafin base, and petroleum spirits from an asphalt base. One or more of these three formed the base for the bulk of substitutes on the market at the time the tests were started. The accompanying table shows the physical properties of each sample, price per gallon, and the standing at conclusion of test:

The excellent showing made by the eight substitutes after 12 months' exposure is remarkable. Sample *A* is the pure turpentine, and as will be seen it gave the best results. It seems to have made no difference as to what the base of the substitute was, for they all stood up remarkably well. For instance, sample *E* finished second in the test, and it was made of petroleum spirits from an asphalt base; sample *G* finished third, and it was made of petroleum spirits from a parafin base; sample *B* finished fourth, and it was made from a wood base. The very little difference in the results obtained from these three kinds of substitutes would indicate that the base of the substitute has little to do with the quality of the finished product.

Looking at these three substitutes from a flash standpoint we have sample *E* with a flash at 96 deg. F.; sample *G* with a flash at 114 deg. F.; and sample *B* with a flash at 98 deg. F., which would indicate that the flash point is not a proper gage for determining the relative value of a substitute. The specific gravity of the three samples *E*, *G* and *B* were respectively .823, .831 and .843, while pure turpentine runs about .866. This also proves that it is necessary to have a practical test in order to determine the real value of the material. By taking the above table and carrying or extending this line of reasoning to all the substitutes affords an interesting study to the practical man, as well as the theoretical. The working qualities of samples *B*, *C*, *D*, *I*, were similar to that of pure turpentine with the exception that neither of the samples flattened out like the pure turpentine. Samples *E*, *F*, *G*, were much slower drying than the pure turpentine. Sample *H* dried more rapidly to the touch than pure turpentine, but when followed up with a succeeding coat it showed a tendency to soften. This was more or less true with all the operations from priming to color coats, which were the same as standard treatment given to passenger cars on the Norfolk & Western. At the time this test was started pure turpentine was 98 cents per gallon, which of course made the substitutes more interesting on account of price, but since pure turpentine has dropped

No.	Color.	Odor.	Specific Grav.	Flash, degs. F.	Boiling point degs. F.	Residue on evaporation (per cent.)	Insoluble H_2SO_4 test (per cent.)	Base.	Price.	Finish at conclusion of test.
A	Water white	Pine	.866	103	320	.0043	20.0	Rosin	$0.98	First
B	Water white	Pine	.843	98	320	.0043	56.7	Wood	.38	Fourth
C	Water white	Oily	.793	97	300	.0016	98.3	Par.	.27	Eighth
D	Prime white	Oily	.818	98	305	.0004	100.0	Asph.	.18	Ninth
E	Pale yellow	Pine	.823	96	310	.0007	95.0	Asph.	.23	Second
F	Prime white	Oily	.778	86	280	.0002	98.3	Asph.	.14	Seventh
G	Water white	Pine	.831	114	336	.0049	96.7	Par.	.30	Third
H	Water white	Oily	.766	110	340	.0020	100.0	Par.	.11	Fifth
I	Water white	Pine	.832	105	318	.0060	93.4	Par.	.37	Sixth

to 46 cents a gallon. As long as pure spirits of turpentine remain around the 50 cent mark it will be given preference by the majority of the painters. Should it advance rapidly in price, as some two years ago, we will have some intelligent information on which to base our future actions.

A test of carbonate of lead against a lead-zinc proposition was also shown. The lead-zinc was a composition of zinc oxide and lead sulphate with approximately 50 per cent. of each material. It is produced by the sublimation process, is very white, extremely fine, and works well under the brush, but on exposure it fails to measure up to the standard set by "Old Dutch Process" carbonate lead. A test of "Old Dutch Process" white lead was made in competition with the same material with an addition of 10 per cent. of asbestine. The asbestine greatly improved the wearing properties of the white lead, but the roughness of the paint film collected smoke, soot, dust, etc., to such an extent that it over-balances the increased wearing properties of the sample mixture. Three coats were applied to each panel made up with pure raw linseed oil. A supposedly high grade metal preserver was exposed in comparison with red lead and a good carbon paint, with the result favorable to the red lead and carbon paint.

VARNISH TEST.

Fourteen samples of the regular purchased stock of exterior coach body varnish were received from roads in various parts of the country for test. They were transferred to specially constructed dustproof cups numbered from 1 to 14, and a correct record made of the name, road, price, and other information. Fourteen first quality, well-seasoned poplar panels 7/8 in. x 8 in. x 5 ft. long, grooved and finished to represent a car siding, were selected, which subsequent to the finishing were sawed into one foot lengths. The panels were given the regular standard treatment for coaches on the Norfolk & Western, which included priming, surfacer (4 coats), rubbing, and two coats of color, and then numbered in gold from 1 to 14 corresponding with the number of varnish samples. The varnish samples were then applied in proper order—three coats of each sample to the corresponding numbered panels, allowing 48 hours between coats for drying. All operations were performed by the same man, under the same conditions, and in as nearly the same time as possible. The panels were allowed to stand one week after the last coat of varnish was applied to thoroughly harden. They were then sawed up into one foot lengths as before mentioned, which produced five panels of each kind of varnish, or 70 panels in all.

A complete set of 14 panels was shipped to each of the following members with a print showing manner of exposure, and they were requested to expose them: J. H. Pitard, Whistler, Ala.; H. M. Butts, Albany, N. Y.; T. J. Hutchinson, London, Ont.; A. P. Dane, Reading, Mass., and O. P. Wilkins.

All panels were exposed during the month of July, and had a southern exposure at an angle of 45 deg., which, by placing them at the points named should place us in position to secure some definite information when the panels are reassembled at the conclusion of the test. There are no marks or anything outside of the numbers to indicate the kind of varnish used in the test, and it is the purpose of the committee to keep the key to the test, and when the final examination is made to report results by number to the association.

The report was signed by O. P. Wilkins (N. & W., Roanoke, Va.), chairman; W. O. Quest (P. & L. E., McKees Rocks, Pa.); W. W. Valentine (T. & O. C., Bucyrus, Ohio); A. R. Giren (C. P., W. Toronto, Ont.); and J. F. Mays (Southern Railway, Selma, Ala.).

VESTIBULE END FINISH

C. A. Hubbs (S. P., Sacramento, Cal.).—Vestibules finished with either natural mahogany or birch stained to match mahogany are the most cheerful, do not show dust like a darker or painted surface, and if not allowed to be out too long before shopping, require but little work to be put in good condition. We have tried a mahogany ground and strippling with oil color, but this is too much like a painted surface and looks muddy. If the new finish of the vestibule is of birch, no shellac should be applied, as the birch contains an acid or sap which causes the shellac to peel in a short time. Varnish should be used next to the stain. Less panels and moldings would tend to make the work more economical. The vestibule finish on our steel coaches is grain mahogany and varnish.

W. Mullendorf (I. C., Chicago).—The interior of the vestibule of a steel car grained to match the interior of the car will be found equally as hard a task to maintain as that of the wooden car. I find the interior of the vestibule painted and finished practically the same as the exterior of the car is the most appropriate finish for this class of work and the only remedy to overcome all of the ailments that the painter has run up against for years in trying to keep the interior of the vestibule up in the natural state. This has been tried out on some of the leading railways of the country, and has given good results from a practical standpoint.

C. E. Copp (B. & M., Concord, N. H.).—It looks better to finish the interior of the vestibule like the interior of the car. If they are so treated when they are built, I believe in maintaining them in that way as long as they can be kept in good repair without too much labor. In the older cars it is best to paint them some suitable tint. We give them one preparatory coat of lead and suitable vehicles, and then finish them with a coat of enamel; the color is about an olive tint and it produces good results. The cars should be built with a less expensive wood in the vestibule and painted in the same manner, from the wood up as to primers and surfacers, etc., as the exterior of the car, but the color should be a harmonious tint.

J. H. Pitard (M. & O., Whistler, Ala.).—The vestibule is much more exposed than the interior of the car and the damage to the wood and finish will be greater than in the interior. For a long time we removed the varnish and bleached out the stains, and maintained the vestibules as they were originally, but found it cost about 4 times as much to maintain them, with the same amount of service, in the natural wood, as it did the interior of the car. We now paint the vestibule of the car inside the same as the body of the car outside, except that we lighten the color two or three shades, so that the vestibule will not be so dark.

Conclusion.—It was voted as the sense of the association that the natural wood, stained or grained finish, makes an appropriate finish for the interior of wood vestibule ends from the standpoint of appearance.

INTERIOR CAR RENOVATORS

A. J. Bruning (L. & N., Evansville, Ind.).—If you scrub a car on the interior once every thirty days for 18 to 24 months, you are bound to cut off the varnish on the edges. Your window sills, blinds and sash stops become weather beaten unless you go over them after each application of soap and water with a renovator. This adds life to the varnish, protects the edges, keeps the window sills from getting weather beaten and makes the car look fresh and new. The renovator should be a light body, non-drying oil, and one that wipes dry and leaves a polish to the work. Cars can also be cleaned with renovator without using soap and water, providing they are taken in time, or before the dirt gets ground into the varnish.

H. E. Brill (A. T. & S. F., San Bernardino, Cal.).—At terminal points a renovator is very useful, providing the car is thoroughly wiped dry and the corners cleaned and dusted. If this is not done the car will look worse than it did before. The work should be directly in charge of a competent painter, as careless use of a renovator is not only a detriment to the varnish, but makes a heavy job when the cars are shopped. I have several cars that have a good many coats of varnish, and with

the use of a good varnish renovator, they can be kept in good condition for several years without applying more varnish.

F. J. Curtis (C. R. I. & P., Valley Junction, Iowa).—The interior varnish of a car should be cleaned by: first, washing with good soap and water, rinsing off and drying with chamois skin, and second, the renovator should be put on sparingly with white cotton waste and then wiped thoroughly with dry waste.

G. Warlick (C. R. I. & P., Chicago).—On a car with a polished surface a liquid made of equal parts of renovator and vinegar will give good results. It should be kept well stirred and only a little used at a time. It takes the dirt off the polished work, and leaves it in very fine condition, and it does not require much labor.

A. J. Bush (D. & H., Oneonta, N. Y.).—I would suggest that you add a little rotten stone to that liquid.

J. H. Pitard (M. & O., Whistler, Ala.).—In some cases, where the varnish has become dull, the car can be kept in service for some little time with the use of a good renovator. Sometimes we begin to use it before the varnish shows the need of it, and that is a waste of money.

C. E. Copp (B. & M., Concord, N. H.).—The nature of the renovator to be used is of course very important. In one instance I found a renovator being used that required that the varnish be removed clear down to the wood when the car was shopped for general repairs. On investigation it was found that by applying this renovator to clean glass and allowing it to stand in a warm room for 7 days it would make a good gold size. I would rather use nothing than a thing of that sort. A renovator should be applied to a clean surface, and should be non-drying, and should not produce a film on glass in a warm room. It should be tested first, and if after standing two or three weeks it shows no disposition to dry, or if the atmosphere evaporates it, it is probably a safe renovator to use. In that case it should be rubbed as dry as possible. I would not apply a renovator on the interior of a car that would produce a film on a test exposure.

T. J. Hutchinson (G. T., London, Ont.).—No matter what renovator you use, it should be made in the nature of an emulsion, and it should never be used or applied by an inexperienced person.

Mr. Pitard.—A very thin liquid cleaner is far preferable to an emulsion cleaner. The emulsion cleaners, in going around corners and moldings, and inaccessible places, are difficult to wipe out, and very often the cleaning is entrusted to careless operators who neglect to get the cleaner out of the corners, and the result is that flying dust will accumulate, and in the course of time the corners will be in a bad condition.

Mr. Hutchinson.—If we had the renovator at the proper consistency before using it on all cars, that might be all right. But very often we have to clean cars that are not shopped, and adding vinegar to the renovator and making it into an emulsion saves time and future trouble, if it does not happen to be rubbed out in a corner here and there.

Conclusion.—It was voted that the association should go on record as recommending that a competent practical painter be placed in charge of all cleaning of equipment of all kinds at terminal points.

CONCRETE CAR FLOORS

A paper was presented by Leo H. Nemzek, chief chemist for John Lucas & Company, Philadelphia, Pa., on the treatment and finish of passenger car concrete floors. An abstract follows:

Concrete is treated both to preserve it and to improve its appearance. The proper method of treating is oftentimes neglected in order to obtain the decoration at the lowest possible cost. Finished concrete will contain a certain amount of quicklime which has a saponifying action on fatty oils. It is very porous and the expansion and contraction resulting from frequent absorption of water has a weakening effect. The greater the proportion of cement the less will be the absorption qualities and the older the concrete the less capillarity it will have. This should be borne in mind when applying the filler coat to the concrete.

Waterproofing compounds mixed in with the concrete tend to weaken it and the same may be said concerning the materials added for decoration. The colors that have proved the most successful are natural earth pigments, which are practically inert and therefore have no harmful effects. Water soluble dyes have been used to give brilliancy with no harmful effects, but the former are to be preferred, as they are fast color, while the stains invariably fade. It is advisable when contemplating finishing concrete in a color, to write to the suppliers of the cement to learn of the coloring materials which can be safely used.

The absorption of grease and oil not only tends to disfigure a floor, but has a disintegrating action. Many types and grades of mineral oil when allowed to penetrate into concrete that was not thoroughly dry were found to possess a disintegrating influence, but on old surfaces there is no noticeable indication of this. Linseed oil in a concrete mixture does not make it waterproof or make it impervious to the absorption of oils.

The natural grinding action or wear on the surface of a concrete floor will cause a dust which readily adheres to the surface of untreated floors, in a manner which makes it impossible to remove it. By painting, the floor is made sanitary, because it may be kept clean and free from all traces of dust and dirt, and oils and grease may be kept from penetrating into the concrete. It is possible to obtain the same color and decoration on concrete floors that is to be had by the painting of wood.

A treatment of the concrete surface which has for its object the elimination of whatever free alkali is present on and near the surface will in practically every instance prove injurious to the concrete. The general results of experiments along this line indicate that it is not advisable to attempt the elimination or change of the alkali to some other form, by chemical reagents.

The most satisfactory results have been obtained by the use of a thin varnish-like mixture which is especially adapted for work of this character. This filler is practically a wash which penetrates into the concrete and destroys whatever action alkali would have on an oil paint coat. In the process of neutralizing any free alkali with which this filler comes into direct contact products are formed, which assist in making a thorough bond within the concrete, without weakening the structure. Capillarity is destroyed by the oxidized film, which results upon drying. The paint coat which follows the filler can then be selected to obtain the desired decoration and will assist in correcting for all the forces that exert deteriorating influences on naked concrete.

In applying the paint two factors must be given careful attention. While the pigment is a requisite of considerable importance, the vehicle will in almost every instance determine the wearing properties. Floors are subject to hard usage. It is necessary, therefore, to use a material which will oxidize to a hard dry film and at the same time retain sufficient elasticity to withstand the strains to which it is subjected. The material best adapted for this kind of work will not alone give satisfactory results. It must be applied in a manner which will insure a thorough bond in the concrete itself.

Ordinary floor paints which prove satisfactory when used over wooden surfaces give equally as good results when used over a properly applied filler. The wear closely resembles that found on a wooden floor. The paint coat invariably possesses somewhat better bonds within the concrete and the service in many cases is superior to that obtained from the same paint applied on wood.

Before applying the filler, all dust and loosely adhering particles of concrete should be brushed away. If the surface is very hard and smooth it may be necessary to go over it thoroughly with a stiff wire brush, as otherwise the penetration will not be sufficient to allow the paint coat to form its hold

within the concrete, with the result that flaking will soon follow. At no time is it advisable to use water in cleansing the floor in preparation for painting; because of the tendency that concrete has for holding moisture, it requires a long time to thoroughly dry out. Peeling is likely to result if the floor is not dry at the time it is treated. Wherever possible, the floor should be allowed to stand for three to five weeks so as to give the concrete ample time to dry out.

When painting floors which have any grease or oil adhering to them, wash them with benzine before applying the filler, otherwise it cannot perform its proper functions. If any neglect occurs in this respect the paint coat which follows will, because of the lack of penetration, soon break away in the form of "scaling." Frequently, concrete floors are encountered which do not dry out evenly, or which show a variation in hardening, due to uneveness in the size of the particles of sand and stone. If a paint coat is applied without first treating the surface with a filler, the finish will lack uniformity and show gloss spots. The use of a filler makes an even appearance certain

case a too heavy application of the filler has been made, it should be cut with turpentine before applying the paint.

It is not necessary to again apply a filler when repainting floors. One coat of paint applied so that it can be brushed out well will give the best results. In preparing the surface for repainting no strong alkali should be used for cleaning, as it will not only act upon the paint, but if not thoroughly removed will also effect the following coat. It is advisable to go over the surface with warm water and soap, and allow sufficient time to elapse for drying.

The accompanying illustrations show the concrete floors under varying conditions. In each case the actual size is shown. Fig. 1 shows a perfect condition of ordinary floor paint applied over a proper filler. The paint film is in perfect condition. Fig. 2 shows an ordinary floor paint over an untreated surface. The disintegration shown was also found in the case of cement floor paints applied over the same surface.

Fig. 3 shows an ordinary floor paint applied over an improperly applied filler. The excessive scaling is clearly indicated.

Fig. 1.

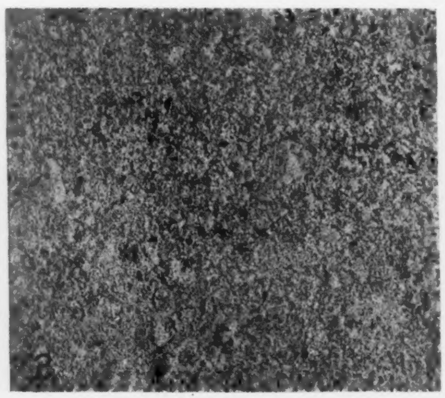


Fig. 2.

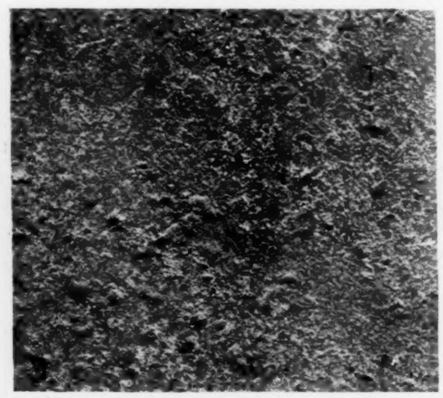


Fig. 3.

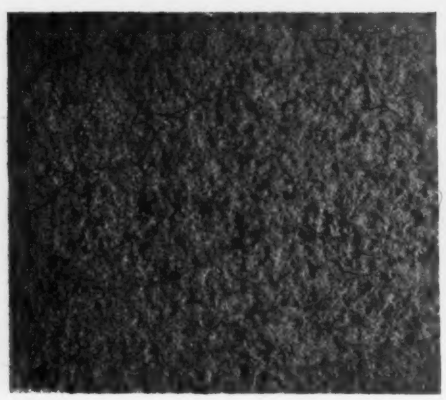


Fig. 4.

Fig. 5.

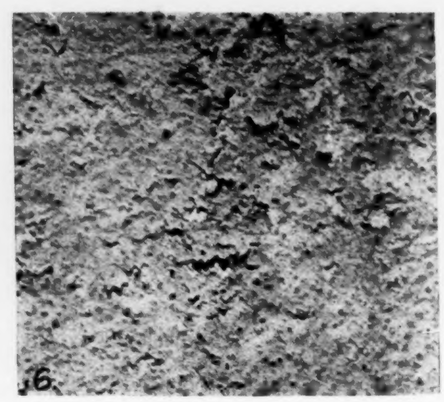


Fig. 6.

Comparison of Concrete Floor Surfaces Which Have Been Treated by Proper and Improper Methods.

While it is true in other branches of painting that the application of several thin coats is preferable to thick coats, this method of application is even more necessary for the painting of concrete floors. While good results can be obtained from the application of one coat over a filler, the best service value is given where two coats are used, the first especially being applied thin.

In applying a filler care must be exercised so as not to obtain a varnish-like surface, which may result from a too heavy application, or in many cases can be tracted to the character of the concrete. When properly applied the filler penetrates into the concrete and when dry the only thing that would indicate its application is a slight staining effect. No gloss should be perceptible. If the surface left after the application of the filler shows a glossy appearance the results obtained by applying a paint coat over it will in most cases prove unsatisfactory. In

The same paint was used on the samples shown in Figs. 1 and 2. The same condition was noted in the case of cement floor paints applied over an improperly filled surface.

Fig. 4 illustrates a brittle character of the paint coat. The vehicle portion of this paint was constructed so as to be only slightly subject to the action of the alkali present in the concrete. Fig. 5 shows the appearance of a paint coat after six months' wear over an untreated surface. This is also typical of the results obtained with cement floor paints under similar conditions. Fig. 6 illustrates the disintegration caused by the action of the alkali in the concrete on the vehicle portion of the paint coat.

REMOVING PAINT FROM LOCOMOTIVE JACKETS

W. H. Pratt (Erie, Huntington, Ind.).—When necessary to remove old paint from locomotive jackets we lay them out flat and cover them with a solution of caustic soda and lime and

hard wood ashes when we have any. This is allowed to stand over night and when the paint is loosened, it is scraped off and the jackets are thoroughly washed with plenty of water. They are then washed with a solution of acetic acid and water, and when thoroughly dry the underside is covered with a good mineral paint and the outside with a primer. This method has given good satisfaction and may be done by a handyman.

J. W. Houser (C. V., Chambersburg, Pa.).—A good plan is to put the locomotive jacket into a lye vat. We have a man in our machine shop who does the lye work on different parts of the engines, and he removes the paint from the engine jackets that are in bad condition. At times it is not necessary to lye off the jacket as a whole, and in those cases we scrape whatever parts are necessary.

J. F. Langerslik (C. C. C. & St. L., Columbus, Ohio).—We find that method the most economical.

Conclusion.—It was voted to be the sense of the association that the best and most economical method of removing old paint from locomotive jackets is to immerse them in a lye vat.

CARE OF STEEL PASSENGER CAR ROOFS

T. Spirk (C. R. I. & P., Davenport, Iowa).—When painting steel roofs be sure that they are free from rust and well prepared for the priming coat. That coat must be of solid pigment and pure oil, well brushed on, so that an elastic crust will be formed which will adhere to the steel and become a good foundation for the following coats. The surface must be covered with a solid body of paint, so dampness and cinders will not get to the steel. You will hardly find anything better than red lead, for a foundation coat, at least.

E. L. Younger (M. P., Little Rock, Ark.).—The steel roof should be sand blasted or pickled before painting, to remove all the scale and rust. A passenger car roof receives harder treatment than any part of the car with the exception of the floor, on account of the locomotive cinders, of workmen scarring the paint while making repairs and on dining cars, while ice is being put in the refrigerator. On account of these injuries the roofs should be painted every six months.

W. O. Quest (P. & L. E., McKees Rocks, Pa.).—The principal trouble in keeping paint on a steel roof is caused by the sun. If you paint over any dross or scale the paint becomes dry and absorbent, and the water will get in and rust the roof. The scale should be removed by sand blasting if possible.

J. A. Pitard (M. & O., Whistler, Ala.).—A good way to remove the scale is by pickling the plate in dilute muriatic acid in a vat. The trouble with steel roofs is not so much from scale as it is from the action of cinders wearing away the paint while the car is in service. On our canvas and tin roofs we paint the ends of the cars with a thick paint containing medium coarse sand to offset the effect of the cinders and it gives good results.

EXTERIOR PASSENGER CAR PAINTING

F. M. Pribble (L. & A., Stamps, Ark.).—The A. B. C. system is used in our shops, and if the carpenters will use surfacer *A*, or the liquid primer that is in use, instead of glue, to stick the sheathing together, much better results will be obtained, as the boards will expand and contract freer, and not injure the painted surface. After the wood has been thoroughly cleaned of dust and the fibre removed from about the screw holes, the primer should be applied evenly, and brushed in well; the laps should be smoothed out to prevent blistering. The primer should be of uniform consistency and penetration. After it has stood 72 hours, the surfacer *B* should be applied, being thoroughly brushed in. The puttying should be done the next day and 4 coats of surfacer *C* applied, sufficient time being allowed for each coat to dry. The final guide coat or stain is then applied, the latter consisting of dry yellow ochre with sufficient *C* surfacer for a binder, and a small amount of light chrome yellow for color thinned to the proper consistency with turpentine. On our road the water and stone method is used for rubbing down. After the car is rubbed and dry, the surface is gone over with No. 1½ garnet paper and the defects faced up with putty; two coats of the body color are applied, the ornamenting done and three coats of varnish applied, three days being allowed between each coat for drying. The sash is treated in the same manner and at the same time as the rest of the car.

On cut-in work the cleaners thoroughly clean the inside of the car, removing seat cushions, etc., and the dust and dirt are removed from both the inside and outside by compressed air. The exterior is then carefully washed down with linseed oil soap. The surface is rubbed with No. 1½ garnet paper which scratches it sufficiently to give a good "toe-hold" for the new coats of color and varnish. The sandpapering precedes the scraping out and puttying because it brings into greater prominence many defects which would otherwise escape the eye of the average workman. The surface is then gone over with a scraper and all fissures, fractures, etc., carefully cleaned out to a solid foundation and touched up with surfacer *B*. These are faced up the next day with hard-drying putty. Should any patching by carpenters be necessary, it is done immediately after shopping and brought to a surface with the balance of the car.

When a scar is hardly large or deep enough to require a patch, but too large for putty, plaster of paris mixed with glue water may be used, and the hole or scar should not be filled quite to a surface. This will dry absolutely hard in a short time, and the glue water imparts sufficient elasticity to insure its holding. When it is dry a little facing up with hard-drying putty gives a smooth finish which is entirely imperceptible.

The gold on letters and stripes is next gone over with steel wool in the hands of a careful workman and cleaned up and brightened to a surprising extent. An hour's expenditure of energy will pay big dividends in the appearance of gold on your cut-in job. The puttied holes are next sandpapered smooth and spotted out with color and the car is cut-in with the body color, the broken gold is touched up, and two or three coats of finishing varnish are applied, according to the requirements of the old surface.

Where systematic car-shopping is in vogue, and the car is returned to the shop for refinishing in a reasonable length of time, the touch-up method can often be employed instead of cutting-in, and a good appearing job be turned out. It is a well-known fact that the greater the depth of pigment and varnish over the old surface, the deeper will be the ugly checks and fissures when they make their inevitable appearance, hence the advisability of "touching-up" if the old surface is in condition to warrant it and broken spots requiring putty and matched color are not too numerous. Systematic terminal cleaning greatly increases the possibilities in this class of work and, indeed, to every phase of coach finishing, and pays big dividends in added life to the varnished car.

This paper deals with ideal conditions, when there is plenty of time to do the work. I give my primer all the advantage in drying I possibly can, because I believe the priming coat is the painter's greatest trouble. We find that it usually takes from 20 to 25 days on a new job or a burnt-off job to get a good piece of work.

E. A. Wittes (Terminal Ry. Assoc., St. Louis, Mo.).—We painted passenger cars with white lead and linseed oil up to about two years ago, but now we use a process by which a car can be finished in about 10 days. The priming is done on the first day; puttying and kniving on the second; sand papering and the first coat of surfacer on the third; two coats of surfacer and sand papering on the fourth; sand papering and two coats of body color on the fifth; lettering and first coat of varnish on the sixth, and on the next three days one coat of straight finishing varnish is applied each day. We do no rubbing or striping on the cars.

QUALIFICATIONS OF A FOREMAN PAINTER

A paper was presented on this subject by C. E. Copp, foreman painter, of the Boston & Maine at Concord, N. H. An abstract follows:

The qualifications of a foreman painter may be classified under four heads; physical ability, mental ability, education and ethics. The exacting nature of the present-day rush in the paint shop requires that the foreman be of sufficient strength to stand the strain. He should be an example of good discipline to his men and then he can with propriety and justice enforce shop discipline. He must not make threats, but what he says he will do he must be careful to perform to retain their obedience and respect.

He should be conversant with new ways to arrive at correct conclusions as to the nature and value of the materials he is using and the results that will follow their use and exposure to the effects of wear and weather. These are found in mechanical and experimental ways and tests. There should be a working harmony between the foreman painter and the railway chemist, or testing department. The practical, experienced painter is a valuable co-worker with the chemist.

The foreman painter should be equipped with at least a good common school education. He should know how to clearly express himself on paper. He will need often to be quick and accurate at figures. He must have an executive and managerial ability in order to produce the most and best work from a large force.

Concerning his ethical status, a foreman painter should be a *Man*, he should not be the tool of anybody—not even of his superior officers, but should have a mind of his own and be fearless in expressing it. He should not be owned, body and soul, by anybody, but be free and independent to express an opinion as to the merits or demerits of materials or methods followed, and to make changes in any of them for the good of the service. It is expected that the foreman painter will have warm friendships, not only with his superiors, but amongst the supply trade, if he is friendly, square and honorable in his dealings, and it is right and proper that he should. But he must reserve the privilege to differ with anybody at any time as to the quality of what he is receiving for supplies and to "kick" when necessary, or to make changes if needful.

REMOVING STAINS FROM NATURAL FINISH

J. R. Ayres (U. & M. V., Syracuse, N. Y.).—We have had fair success with the following solution where the stains were not too deep. Dissolve one pound of oxalic acid in 1½ gallons of water. Take 8 ozs. of cream of tartar and add slowly enough hot water to dissolve the tartar. Allow this to cool and stir in the acid solution. Apply the mixture with a brush over the parts to be bleached and when dry, sand paper to remove the coating. If the stain is not removed repeat the operation and wash thoroughly with hot water.

On stains that cannot be removed with this solution, I have used the following: Dissolve 4 lbs. of chloride of lime and ½ lb. of soda crystals in one gallon of water. Cover the spots with a thin layer of white cotton waste and keep the waste saturated with the solution until the discoloration has been removed. Then wash it with a solution of sulphuric acid and water to remove the chlorine.

These formulas will remove almost any discoloration but the grain of the wood will be raised and it will be necessary to use a cabinet scraper in order to resurface the wood before refinishing.

J. W. Houser (C. V., Chambersburg, Pa.).—We have used oxalic acid for many years with good success. I have had better success by adding a little alum to it. We have done much cleaning in that way, and it obviates the scraping.

E. F. Biegelow (N. Y. C., W. Albany, N. Y.).—We have always used oxalic acid applied hot and allowed it to dry, and then washed off again with hot water, the wood being allowed to dry before proceeding to finish. That will take off a water stain, but we find on our ash and oak cars quite a number of other stains, particularly the stain that comes around a nail which the oxalic acid will not remove.

C. E. Copp (B. & M., Concord, N. H.).—If a new oak headlining comes to you unfinished, and you undertake to take out any stains by the application of acid, provided those stains have any residue of iron in them, they will look worse than ever after a while.

W. O. Quest (P. & L. E., McKees Rocks, Pa.).—If you attempt to varnish the same day you do your bleaching, and do not allow ample time for the bleaching to dry, it will turn all kinds of colors, otherwise you will have no trouble. If you will use four parts of oxalic acid and one of common washing soda, you will find it has less tendency to turn the work dark. You can make your oxalic acid yourself. It is simply nitric acid and sugar, and is, of course, a deadly poison. On account of the sugar it will naturally be sticky, and if you attempt to varnish before it is dry, your varnish remains tacky. It is like a coat of shellac; you must not varnish either before they are dry. We do a lot of bleaching. We do not tear off the varnish when an abrasion occurs. Our men are on piece work, but we put the men on day work to bleach out the spots.

J. S. Gilmer (So. Ry., Knoxville, Tenn.).—As to the iron stains, the tannic acid in the solution makes tannats of iron, which is dark. Take tincture of iron and tannic acid and mix them together, and while each is a kind of yellow liquid, they will immediately turn perfectly black. That is the trouble in those stains. We have had some experience in getting rid of them. We took nitric acid and put it on the black spot. That will turn it a kind of brownish yellow, and to get rid of that I use caustic soda on the nitric acid; afterward we rinse it off and bleach it with oxalic acid. We have got very good results. We clean our seat ends by dipping them in a vat of caustic soda and as the varnish is loose enough to remove we take them out and rub it off with a stiff brush. It is then rinsed off and allowed to bleach in a vat of warm oxalic acid. The mahogany will bleach perfectly, but with the oak we sometimes have to let it dry, wash off and dry again, then return to the vat again. By careful watching the acid will not eat in enough to loosen the joints. It is estimated that this method is twice as quick as scraping.

T. R. Cowan (C. P., Montreal, Que.).—We have had trouble with oxalic acid. Our cars have real mahogany for the exterior finish. We have never had any trouble with the varnish. The difficulty we find is that it seems impossible to bleach out mahogany. Even when the carpenters scrape it, the stain is still there. We can get nothing that will help it. We touch up the black spots with one color and when the car comes back we find an altogether different color.

T. J. Hutchinson (G. T., London, Ont.).—When you have bruises and blemishes in the mahogany, the cabinet maker must remedy it. We paint them out and grain in imitation, and we find that is satisfactory in a sense.

MAINTENANCE OF STEEL AND WOODEN PASSENGER CARS

John Gearhart (Penn. R. R., Altoona, Pa.).—We have up to the present time been getting about 50 per cent. more service from the steel than from the wooden cars; in fact, since the advent of the steel car on our lines about the only people yet called on for repair work are the painters and truck repairmen. As to the relative difference in the cost of maintenance on the exterior of cars, after almost five years' service of the steel car it is our impression that this maintenance is greatly in favor of the steel equipment; our experience with wooden cars showed that every time a car was shopped for class or slight repairs it was necessary to replace anywhere from a half-dozen to a dozen panels and the same number of battens due to the panels being

split or being scraped by baggage trucks, etc., which, of course, is all eliminated on steel equipment.

On the interior of the steel car we are having more or less trouble with rust due to acids, etc., used when the cars are under construction; we have also experienced considerable cracking of the paint and varnish. This latter trouble will be overcome in time as we are now getting ready to change our practice from air to mechanical drying by installing a baking oven sufficiently large to take care of the largest of our passenger cars.

G. Warlick (C. R. I. & P., Chicago, Ill.).—We have just passed through the first shopping of our steel cars. On our road there are about 200 steel passenger cars and about 1,100 wood passenger cars. The cost for the exterior of the steel passenger cars when they are shopped for Class 1 repairs (which means cutting in and varnishing) is about the same as a wooden car of the same size; the interior of the steel cars is finished in mahogany and oak and receives the same treatment as a wood car and costs about the same for labor and material. There is, however, a saving on the floors of a steel car which do not have to be painted. The cost of painting a car which comes in for Class 2 repairs (which means removing the paint by sand blast or other methods) will be about 10 per cent. more than for a wooden car; there will also be an additional expense of glazing or scraping in; you can figure about $8 to $12 for this operation.

The roofs will require more care, as they will have to be brushed with a steel wire brush to remove rust and keep them well painted. While there may be, as above stated, more labor on the steel car, it is turned back into service sooner, which evens up the difference in the cost of maintenance.

Mr. Gearhart: The maintenance of the roofs on some of our cars has not cost any more than to coat them over. We are giving them two coats instead of the one we used to give the canvas roof. My experience has been that it is better to have everything on a steel car sand blasted. We made some tests, and in the instances where we did not remove the scale, inside of two years the scale was removing the paint. I would sand blast the cars all over when we repaint them. The cold rolled steel should be sand blasted for we find the paint is coming off the inside sheets. We should have insisted upon the manufacturers sand blasting it before they painted it.

O. P. Wilkins (N. & W., Roanoke, Va.).—One reason for not sand blasting the roof is that it does not receive the same treatment as the rest of the car. My experience has been that where sand blast is used, and you only put on a few coats of paint, the film is very thin compared with the body of the car and it soon wears through and corrodes. I found that a surface not sand blasted was better after three years than one sand blasted. I reasoned that the sand blasted surface is more or less honeycombed; these little pinnacles that project up through the thin paint wear off and expose the iron and corrosion sets in, and it reaches under the paint. By using acid pickle and a vat for the roof sheets, we thought we would get better results than with the sand blast, as our cars are to receive only four coats of paint.

W. O. Quest (P. & L. E., McKees Rocks, Pa.).—A heavy sand should be used in sand blasting, for the light sand will not get all the scale off. It should be about the size of rice.

FREIGHT CAR ROOFS

W. Bailey (B. & M., Concord, N. H.).—I question the necessity for the painting of the roofs. From the experience I have had I have about come to the conclusion that there is very little if anything to be gained by painting them.

J. H. Pitard (M. & O., Whistler, Ala.).—I differ with Mr. Bailey. Very often the best of lumber is not used in our car roofs, and unless everything that can be done is done to preserve them, they very quickly become bad.

W. H. Truman (N. & S., Newbern, N. C.).—We generally give them one good coat of oil primer. I do not believe it is economy to apply more than one or two coats.

G. Warlick (C. R. I. & P., Chicago).—I think the freight car roofs should be well protected. The money paid out by the railways on damages for goods spoiled by water is tremendous, and everything that will add to the preservation of a car roof is real economy.

J. W. Fryer (N. C. & St. L., W. Nashville, Tenn.).—We use spruce for car roofs, and judging from the experience we have had with it, I believe it lasts better without painting.

G. Derrick (P. M., Grand Rapids, Mich.).—We carry a great deal of furniture, and find it more necessary to protect the roofs than even the sides of the car. We put two coats of paint on all our roofs.

Mr. Bailey.—Of course as long as the wood has moisture in it, it will rot. Suppose you put two or three coats on your roof; with the men going over it in their work, they will break the paint clear of the wood. A little hole in the paint will allow moisture to get under the paint, and it will not dry out as quickly as it would without any paint there.

G. Schumpp (L. & N., Louisville, Ky.).—We have a double layer roof on our cars. For the last four years we have not painted our roofs at all. We dip them first in linseed oil, and lay them out to dry, stacked up. Then the carpenter puts them on. We built 150 stock cars four years ago, and we find that our roofs, prepared as I have stated, last better than any other roof we have tried.

J. H. Whittington (C. & A., Bloomington, Ill.).—I believe the dipping process is good. We made a large trough, deep and wide and long enough to take in fifteen or twenty boards, and on the inside of the trough we have four brushes, so fixed that they come together. We rigged the device up ourselves. We use common laborers and after the boards are in for a few minutes, we put them through the brushes, and it takes off the surplus paint.

A. Hunicke (M. K. & T., Sedalia, Mo.).—Our material, yellow pine, white pine, etc., contains a great deal of pitch and resin, and it is necessary to paint them. If you do not, they will rot in a short time. We have a machine run by electric motor, and it dips 1,200 boards an hour. They run through about 12 ft. of paint, and the surplus paint is drained off at the other end. If a roof is thoroughly saturated in that manner, we find that in the hot sun and the various weather conditions we have in our section, it will last a number of years longer than if it were not treated at all.

T. J. Hutchinson (G. T., London, Ont.).—In London we paint our roofing and sheathing in a stack, with a long-handled brush. We do enough at one time to last us a week, and we aim to have a week's supply ahead to dry. We take particular pains to see that the roofs are thoroughly painted, because we had a number of claims made for damage to grain shipped in them. We supply our out-stations with a stencil to mark all roofs that are not safe or watertight, as a guide to the shippers. I think the initial painting of a freight car, particularly the roof, is the important part. I believe much of the money paid for damaged merchandise might be saved if the practice was followed generally.

W. O. Quest (P. & L. E., McKees Rocks, Pa.).—We dip our roof boards before giving them their regular coat of paint. They are run through a trough which has an arrangement of scrubbing brushes on one end. Even though you have a double roof, the lower roof being of galvanized iron, we have to look to the preservation of the wood, for it will dry up and the tongues and grooves will fail to meet. If you have them tongue and grooved and well painted, and driven up well, you have a better chance to hold the roof in place.

Conclusion.—It was voted to be the sense of the association that it is considered good practice that all roofs of freight cars

be well protected with paint. Either creosote or paint can be used.

OTHER BUSINESS.

The next place of meeting will be selected from the following three places, Ottawa, Can.; Detroit, Mich., and Chattanooga, Tenn.

J. F. Enright, superintendent of motive power and car department of the Denver & Rio Grande, and Warner Bailey, retired master painter of the Boston & Maine were elected honorary members.

The following officers were elected: A. J. Bush, Delaware & Hudson, Oneonta, N. Y., president; O. P. Wilkins, Norfolk & Western, Roanoke, Va., first vice-president; T. J. Hutchinson, Grand Trunk, London, Ont., second vice-president, and A. P. Dane, Boston & Maine, Reading, Mass., secretary and treasurer.

CAILLÉ FEED WATER HEATER

BY H. H. PARKER

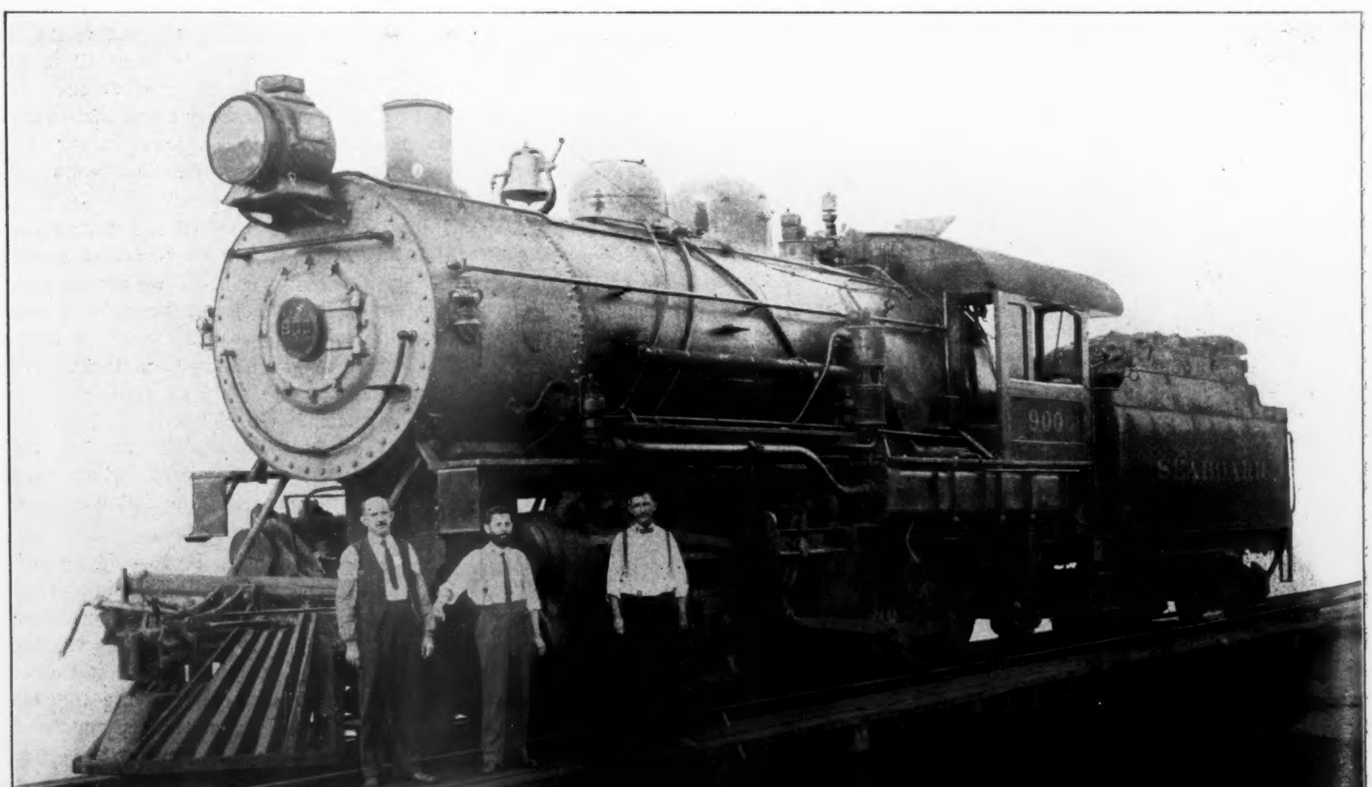
A design of feed water heater for locomotives, which since its invention in 1908 has met with much success on the railways of the Continent, particularly in France, has been experimentally applied to a large consolidation locomotive on the Seaboard Air Line. This heater is of the type that employs exhaust steam which is conducted to a drum where it circulates on the inside of a nest of tubes and is condensed by the cold feed water which fills the drum around the outside of the tubes. The condensed steam is discharged to the right of way between the rails. The feed water is handled by a double pump which simultaneously draws cold water from the tank and forces it in the heater and with the same stroke draws water from the top of the heater and discharges it to the boiler.

The diagram shows the arrangement of the apparatus as applied to some French locomotives, which illustrates the principle but not the exact construction used on the Seaboard Air Line. It will be seen that there is a passage from the exhaust pipe, entrance to which is controlled by a valve that can be adjusted by the engineman. Through this passage the exhaust steam is carried to one end of the heater where it communicates to a closed header at the forward end of the nest of tubes that are enclosed within a large steel drum which is carried under the running board. In passing through the length of the tubes it is condensed and discharged from the heater at the opposite end. The feed pump is very similar in design to a Westinghouse air pump, having the same type of steam cylinder and valves; on the Seaboard Air Line it has two separate cylinders, one below the other. It is secured to the frame underneath the cab and back of the heater. Water from the tank flows to the lower pump cylinder by gravity, and is discharged to the bottom of the heater. The upper cylinder takes its suction from the top of the heater drum, and discharges directly to the boiler check valves on the left hand side in the usual location. The suction for hot water is at the opposite end of the drum from the cold water inlet.

In addition to the steam from the exhaust pipe, the exhaust from the air pump and from the hot water pump are also carried through the heater and will keep the water hot while the locomotive is not moving. It will be noticed that there is a spring operated valve in the exhaust steam line before it reaches the heater which acts as a temperature regulator and will be seated when the pressure in the nest of tubes reaches a pre-determined point. There is also a safety valve at the opposite end of the drum to prevent too large a pressure on the nest of tubes.

In the cab are located three extra gages, one showing the water pressure in the heater drum, one showing the temperature of the water in the heater, and the third in the French arrangement showing the pressure on the hot water feed pipe, but in the American adaptation this gage shows the steam pressure on the pump line.

The preliminary trips of this locomotive preceding the test runs, indicate that the advantages claimed abroad will be sub-

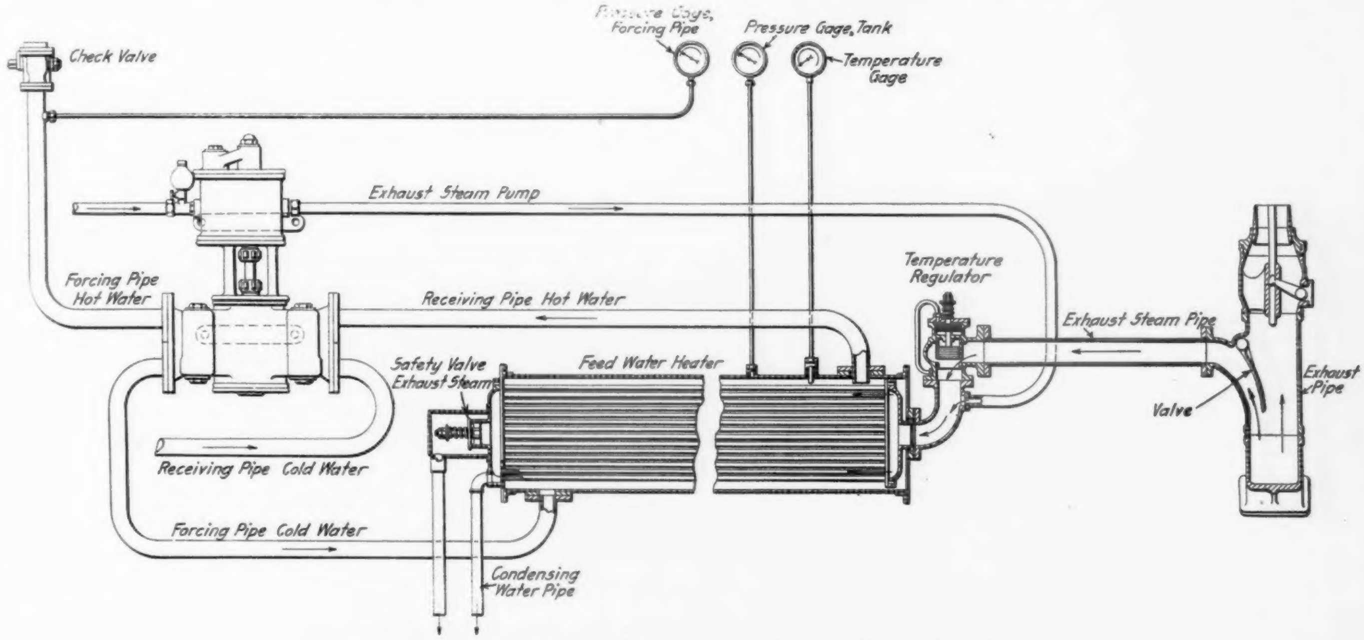


Consolidation Locomotive on the Seaboard Air Line Fitted with a Feed Water Heater.

stantiated. On one of the runs when the train was on a heavy grade and the engine was working to its capacity, the steam pressure at the time being 185 lbs., the pump was started and delivered water at 210 deg. temperature to the boiler and during the time it was running the steam pressure continued to rise. Under the same conditions if the injectors had been used the pressure would probably have been reduced at least 10 lbs.

A 5¼ in. nozzle is standard on these locomotives, and when the heater was first applied a 5 in. tip was inserted with the idea that since a certain proportion of the steam passed to the heater, a smaller tip would be necessary to give the desired draft. After the first trip, it was changed back to 5¼ in., and it is believed that it can be still further increased and still maintain a temperature of between 200 and 215 deg. in the heater.

While no data as to economy is yet available from this locomotive, the tests which have been made on foreign railways indicate that a fuel saving of from 14 per cent. to 16 per cent. can be expected. In Roumania a difference of 16.55 per cent. in the amount of fuel was indicated on alternate runs of locomotives fitted with a feed water heater and with injectors. On the French Northern Railway the tests showed an economy of 17.5 per cent., while on the French State Railway a saving of 16.75 per cent. was indicated in freight service. The results of these tests has led to the application of large numbers of this type of heater to locomotives in France, as well as in Belgium, Russia and Spain. Middendorf Williams Company, Baltimore, Md., are the American agents for Huffer Company, Paris, who control the rights of this device.



Diagrammatic View of a Caille Locomotive Feed Water Heater.

Large Shipment of Farm Tools.—The Great Northern recently shipped to Winnipeg, Man., the largest trainload of farming implements which ever arrived in Winnipeg in a single consignment. It consisted of two sections, totaling 100 freight cars, each carrying a tractor engine. The duty on this machinery was $62,000.

Automobile Production.—At a recent conference between railway officers and automobile makers at Detroit, Mich., it was stated that 100,000 freight cars would be required during the twelve months of 1913 to make the necessary shipments. This would amount to 2,000 cars a week, and an estimated yearly production of 330,000 automobiles.

SHOP SCHEDULING AND ROUTING SYSTEM

Henry Gardner, supervisor of apprentices of the New York Central & Hudson River, read a paper on "A Practical Application of the Routing System to Locomotive Repairs," at the September meeting of the Central Railway Club. A number of years ago Mr. Gardner devised a shop schedule system* for the Concord, N. H., shops of the Boston & Maine, which was introduced with splendid results. The schedule which he described at the club meeting was one which he developed and introduced in the West Albany shops of the New York Central. This shop has an output of 80 or 90 engines a month, and naturally requires a rather more elaborate schedule system than the one which was used at Concord. The following article is based upon Mr. Gardner's paper, the discussion at the meeting and informal discussion on the boat which brought the club members back from Dunkirk to Buffalo.

This system primarily gives in advance a date to each foreman for finishing every leading operation that is performed in his department. When an engine arrives on the pit the schedule clerk looks it over carefully and notes the class of repairs and the different parts which are to be repaired or renewed. He then goes to the schedule office and makes out a set of dates which show when all of these parts or operations should be finished in any one department and moved to the next department, or to the erecting shop ready for the engine. Each foreman of a department gets a sheet with a set of dates for all the material which he handles. In some cases two or more foremen will receive the same dates for the same material, so that they can check each other if mistakes occur.

The work is laid out in the office so that the schedule clerk can tell at a glance just where each piece is, when it went there, and when it will be delivered to the erecting shop. He can tell when each portion of the engine will be assembled and when it should be delivered. He can also tell when a piece is delayed in any department and the cause, and can hurry the material or straighten out the trouble, whatever it may be. Each day the schedule office issues a report showing the condition of the work in the shop and just what operations or delivery of material should occur on that day in each department. Another

*See *American Engineer & Railroad Journal*, May, 1905.

daily report issued by this office tells where each part is delayed and how many days it is late; in the "Remarks" column on this form is given the cause for the delay and the date the part or operation is promised to be completed.

The schedule office contains but two men, a foreman, or chief clerk, and an assistant. This small force is all that is required to give out the dates for repairing more than 80 engines a month. Since each engine calls for 278 dates, under this system an output of 80 engines a month means that the schedule clerk and his assistant must find and write down 22,240 dates per month. This would be an impossible task for two men if it were not for a special calendar slide rule which when once set for a certain schedule makes it a short job to call off the dates. A schedule sheet or "key" sheet is used with the rule and each engine or class of engine has its own fixed schedule.

The schedules and route sheets are made up from a knowledge of the work that the shop can do and has done in the past. Some engines are given 18 days, and others 14 or 24 days, according to the work to be done upon them. When the total number of days for an engine is determined, each separate erecting shop operation is allowed a certain time and then all the departments concerned are given dates conforming to these dates, because, as already stated, the whole scheme hinges upon the delivery date.

There are many different blanks and forms of several colors used in this work, but they would in any case have to be varied to suit the conditions arising in each shop where this system might be introduced. The principles, however, will apply to similar work anywhere. Some of the forms are used to convey the dates from the schedule office to the foremen, while others, on pink paper, are delay or condition reports. There are also check sheets used by the assistant who goes into the shop each afternoon and checks all the operations and material listed in every department. This checking is very important, and upon it depends the delay and condition reports referred to.

One interesting feature of this work is the despatch board in the schedule office. This board is about 5 ft. long x 3½ ft. wide, and is ruled into small squares made by 73 vertical and 30 horizontal columns. The vertical columns stand for all the scheduled operations and material, and in order to locate them quickly a horizontal T square slider is used on the board and the names of the parts are printed on the slide—one name for each column. The horizontal columns represent the days of the month. When a job is scheduled for a certain day the engine number is entered on the line for that day, and in the column for the class of work to which the job belongs. Then by pushing the T square slide up to the line for a given day all the operations and material for that day are shown by reading the entire length of the line. When too many engine numbers appear in any one square it means that the department interested is overloaded and the schedule clerk moves some jobs ahead or back to relieve the congestion.

This system literally ties together all departments concerned and its effect upon the foremen and workmen is quite noticeable. There is much less friction between departments, since the dates stand for the general foreman's order to deliver the material, and any man going to a department to hurry some part is told that he will get it on the date set for it. The responsibility is never placed upon the wrong man, and when a workman is at fault the delay report shows it correctly, and if he has a blackboard over his bench for recording dates the board advertises very plainly the fact that he is delinquent. These assigned dates are just like so many tasks or jobs given out in logical order by the general foreman, and every man works with better satisfaction when he knows each day just what he is going to do and that it is just what the superintendent wants him to do.

Under this system the piece workers get more work and get it regularly, which results to their benefit. The foremen all like the system, because, if lived up to, their labors are very much lightened. They do not have to continually rush about prodding first one department and then another, and consequently their time is put in to better advantage supervising and instructing the men and forwarding material. The result of all this is better and more accurate work and more contentment and good feeling all over the plant. It is hard to estimate the cost of lack of harmony in a shop, but the co-operative spirit induced by systematic methods is greater than usually realized.

No claim has been made by the management for any direct saving in cost of repairs under these improved methods, but if such a system as described is religiously lived up to it cannot fail to decrease shop operating costs. There will also be a saving from quicker deliveries of engines since these schedules provide for minimizing delays and an engine is worth from $40 to $50 a day to the company.

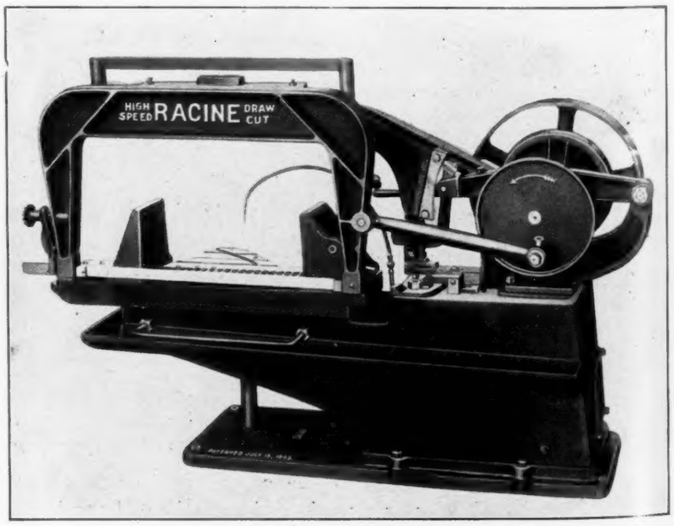
This routing system is not properly defined as scientific management, but is a form or type of these advanced methods. It is scientific management in so far as any modern and efficient form of management may be termed scientific. The schedule office, as it is called, is very closely allied to the planning department advocated by F. W. Taylor, H. L. Gantt, H. Emerson and others.

There can be no question but that this work is a step in the right direction, as has been confirmed by the railways who have adopted similar methods. But no new system will succeed without the hearty support of the management; not only the foreman and the superintendent, but the superintendent of motive power and the general manager must give it their endorsement and approval. Men are quick to notice whether a new plan is backed or not, and human nature is such that, without proper backing, the best system may fail through neglect to conscientiously follow its principles.

As we view it this system forces everybody to do his duty. The man in authority who wants a system which will force everybody else to do his duty but leave him free to do as he pleases is too often evident; such a man could not introduce this system successfully; having once endorsed it he also must live up to the dates and schedules. Unquestionably this work will become more and more popular in railway repair shops; the principles involved can be applied to the car shop as to the locomotive shop, and to the little or the big shop.

HIGH SPEED METAL CUTTING MACHINE

A machine using a flat saw blade which will cut through a 6 in. diameter bar of machinery steel in 20 minutes, or through a 12 in. I-beam in 10 minutes, leaving a face which is true and



High Speed Metal Saw.

square, is being built by the Racine Tool & Machine Company, Racine Junction, Wis. It is a development of a power hack saw carried to a point where it becomes a tool of precision and can be classed with other high grade machine tools. While it uses a saw blade, the frame carrying it is remarkably rigid and is carried by a support, so designed as to prevent any possibility or tendency for movement outside of the true vertical plane. The cutting is performed by the draw stroke and the blade is lifted clear on the return stroke. A geared circulating pump applies a cutting compound to the blade while in operation, allowing it to be run efficiently at high speed.

The machine consists of a substantial base on which is mounted the vise for carrying the work and the frame carrying the driving mechanism. The vise is arranged to swivel at any angle up to 45 deg., and has a capacity for cutting an 11 in. bar at this angle. The saw frame is supported at the top by an arm which is pivoted near the driving shaft. An eccentric on the shaft, operating through an auxiliary arm that is connected with the main arm through a toothed quadrant, lifts the frame and blade slightly when the saw is on the return stroke. The power is transferred to the frame through a connecting rod attached at a point on the frame very close to the connection of the blade. Arrangement is made so that the saw frame remains automatically at any height when lifted up, allowing the stock to be placed in the machine without interference. This machine will accommodate stock measuring 12 in. x 15 in., and uses blades from 17 in. to 24 in. in length. It has a net weight of 500 lbs., occupies a floor space of 24½ in x 66 in., and has a height over all of 41 in. It can be arranged for either belt or motor drive. In the latter case a speed box is provided giving three different speeds.

BEAUDRY PEERLESS HAMMER

A new power hammer of the belt driven type, designed for comparatively light general forging and specially for tool work or other forging that requires extreme quickness of blow, has been designed by Beaudry & Company, 141 Milk street, Boston. This hammer, like its heavier predecessor, has no beam, coil springs, leather straps or rubber cushions, every working part being made of steel. The ram, which can be obtained in seven different weights, varying from 25 lbs. to 200 lbs., is connected to the spring arms by two pairs of steel links. These are arranged to give the maximum freedom and lift of the ram and impart through the spring arms a very elastic blow. The tension on the spring arms and links is adjusted and maintained by tension nuts in the spring box.

A foot treadle extending around the machine is connected to the idle pulley bearing against the loose belt and by means of a varying pressure, any desired speed or force of blow can be obtained. A brake band fitted around the extension of the driving pulley is connected with the arm of the idle pulley so that the hammer is stopped instantly when the treadle is released.

The anvil is cast separate from the bed and is attached to it by bolts at the base and by two strap bolts. A wood filler is inserted between the anvil and the bed to eliminate vibration. The anvil is so placed that any length bars can be worked either way of the dies and it has an independent and adjustable shoe.

Special attention has been given to the material and the design of all parts of this machine. The ram is of steel fitted in heavy U-shaped guides. Arrangement is made for adjusting it on the connecting rod to allow for varying heights above the dies. It is, however, at all times almost wholly contained within its guides, insuring perfect alinement and a true, square blow. The guides are fitted with taper gibs to take up any wear that develops.

New Beaudry Peerless Power Hammer for General Forging Work.

NEW CAR WHEEL BORING TOOL

Two hundred cast iron wheels bored in 10 hours is a record made recently at one of the plants of a car manufacturing company. These wheels were all for 5 in. x 9 in. axles, the size of the bore being 6½ in. Each wheel was bored in two independent cuts to fit standard gages. The boring machine was a Niles, about four years old, and the Davis expansion car wheel boring tools

of an especially powerful design, recently developed primarily for boring steel wheels, were used.

The boring tool used does not differ greatly in principle from the former "two-in-one" tool designed by the Davis Boring Tool Company of St. Louis, which has made such a wonderful improvement in the output of car wheel boring machines. These tools are fitted with two cutters, each being arranged for micrometer adjustment. The lower one is a roughing tool, and

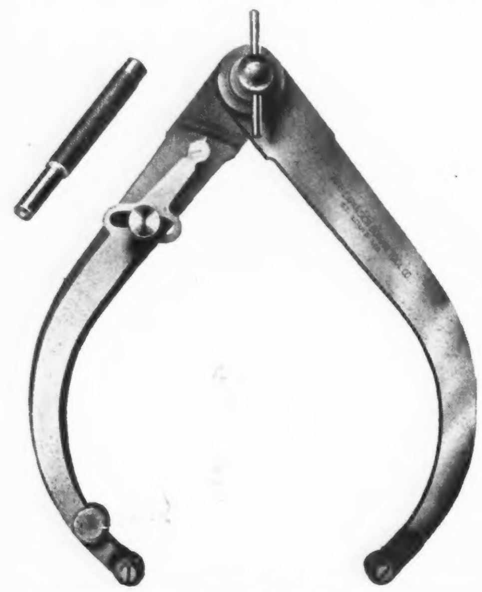
Expansion Boring Tool for Cast Iron Wheels.

with it the hole is bored to very near its finished size. After it has passed through, a single cutter in the upper part of the arbor is provided for chamfering the hole. This cutter is quickly adjusted by means of a screw and can be easily removed after the finishing cutters have started to bore. After the hole is rough bored and chamfered, the finishing cutters are expanded to the proper size, the actual time required for this operation

Expansion Boring Tool for Steel Wheels.

being about six seconds. They are then passed through with a very coarse feed since only a light cut is required and a perfectly smooth hole results.

On the tool for steel wheels the shape of the cutting edge has been changed somewhat and the body of the tool has been strengthened for heavier work. For use in setting the cutting



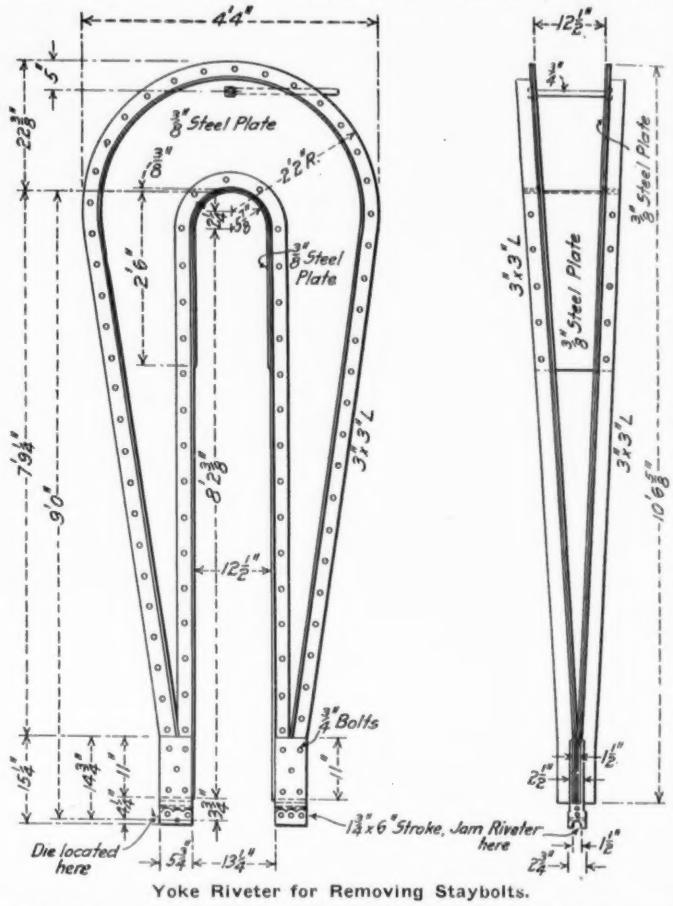
Micrometer Calipers for Setting Boring Tools.

edges of these tools a type of micrometer caliper has been developed with which the wheel fit on the axle can be calipered and the amount of reduction desired for the fit can be made by shifting the leg of the caliper which carries an arm on a micrometer scale, as is shown in the illustration. With the caliper thus set, the cutting edge of the tool can be adjusted directly to size. For the next larger axle the micrometer leg only is reset and the difference in the reading noted. The cutters are then adjusted by their dials to the increased size. Thus by using the micrometer reading on the calipers the cutters can be accurately made larger or smaller without direct calipering.

YOKE RIVETER.

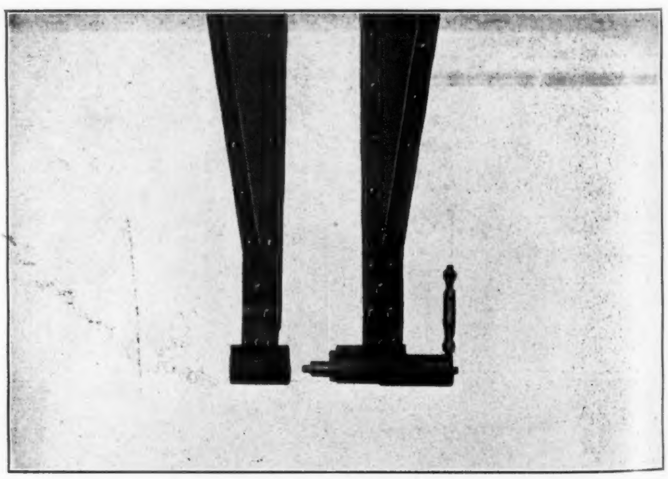
BY Z. B. CLAYPOOL,
Apprentice Instructor, St. Louis & San Francisco, Springfield, Mo.

The yoke riveter illustrated is used for removing short pieces of staybolts left in the outside boiler sheets, after they have been broken down with the staybolt breaker and the firebox has been removed. The boiler shell is stood on end and the yoke riveter



Yoke Riveter for Removing Staybolts.

is hung over the shell from a jib crane, and with it the short pieces are knocked out of the holes. This method has proved more efficient and economical than previous methods. The cost of material was $ 0.63, and the cost of labor was $53 57, a total



End of Yoke Riveter Showing the Tool and Die.

of $124.20. The jam riveter, die and holders were purchased from the Chicago Pneumatic Tool Company. The riveter has a cylinder diameter of 1¾ in., and a stroke of 6 in. The frame was built at the Springfield shops, and has been in service about two years.

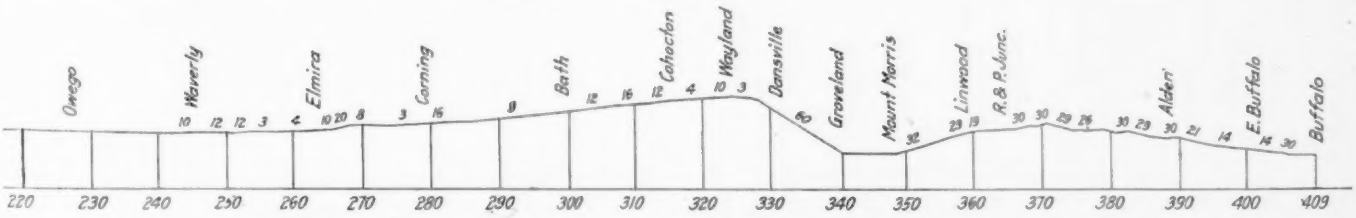
COMPARATIVE TESTS OF FREIGHT LOCOMOTIVES

Records of Mikado and Consolidation Engines in Regular Road Service on the Lackawanna.

A saving of from 29 per cent. to 32 per cent. in coal and 27 per cent. in water per ton-mile in freight service has been effected on the Delaware, Lackawanna & Western by the introduction of a heavy and powerful class of Mikado type locomotives of the latest design in place of consolidation locomotives of a straight forward conventional design. This is shown by the results of comparative road tests between the new Mikados built for this company by the American Locomotive Company, and described in the September, 1912, issue of this journal, page 459, and consolidation locomotives previously used in the same service and purchased last year from the same builders.

As a result of their greater economy, the Mikados, though 32 per cent. heavier and much more powerful than the consolidations, burn 21 per cent., or from 2 to 3 tons less coal per trip than the latter, and yet haul 14 per cent. heavier trains at the same or higher speeds.

The trials were in no sense a scientific test to determine the relative efficiency of the two designs. The object was merely to compare the performance of the two classes of locomotives with respect to fuel and water consumed and load and speed in the same service and under average operating conditions,



Profile Delaware, Lackawanna & Western Between Owego and Buffalo on the Lackawanna.

with a view to determining just what average benefits, if any, the Mikados effected in handling the traffic.

All observations were made on the Buffalo division between Elmira and East Buffalo, a distance of 141 miles, the profile of which is shown in the illustration. Records were kept of

TABLE NO. 1.

SUMMARY OF AVERAGE RESULTS.

	Westbound. 2-8-0.	Westbound. 2-8-2.	Per cent. Difference.	Eastbound. 2-8-0.	Eastbound. 2-8-2.	Per cent. Difference.	Average Per cent.
Distance	141	141	....	141	141	....	....
Ton-miles per trip	420,537	469,248	11.5	332,533	386,183	16.1	13.8
Scoops fired per trip	1,564	1,491	....	1,263	1,275	....	....
Coal fired per trip, tons	13.7	10.8	21	11.05	9.25	19.4	20.2
Time, total, hrs. & min.	10.25	10.17	....	11.17	9.10	....	....
Time, dead, hrs. & min.	2.18	1.38	....	3.08	2.21	....	....
Running time, hrs. & min.	8.07	8.39	....	8.09	6.49	....	....
Speed, miles per hour	17.3	16.4	5	17.6	20.7	17.6	6.3
Pounds of coal per 1,000 ton-miles (exclusive of engine and tender)	65	45.9	29.4	66.7	47.5	28.8	29.1
Pounds of water per 1,000 ton-miles (exclusive of engine and tender)	571.3	....	....	....	*416.	....	27.2

* Average for all trips.

four runs of each class of locomotive, two in each direction. A short run from Elmira to Mount Morris was also made with one of the consolidations. As this is not exactly comparable with the through runs, the record of this trial is not included in any of the following tabulations of average results, except in Table No. 2, which shows the relative performance from Elmira to Wayland.

The consolidation locomotives were comparatively new and have been in service only a year and were in good condition

TABLE NO. 2.

COMPARATIVE AVERAGE RESULTS ON EASY GRADES.
Elmira to Wayland (Westbound).

Type.	2-8-0.	2-8-2.	Per cent. Difference.
Distance, miles	62½	62½	....
Time, total, hours and minutes	5.00	4.07	....
Time, delayed, minutes	.48	.41	....
Running time, hours and minutes	4.12	3.26	....
Speed, miles per hour	15	18.25	21.6
Tonnage behind tender	2,989	3,328	11.4
Number of scoops	1,016	826	....
Coal, pounds	17,780	11,977	23.6
Pounds of coal per 1,000 ton-miles (exclusive of engine and tender)	95	57.6	39.3

of repair. Whatever advantage there was between the two classes of locomotives in this respect was, of course, however, in favor of the Mikados. To offset this, however, the enginemen were not familiar with the operation of the Mikado locomotives.

Coal was measured by the number of scoops fired, the average weight of a scoopful having first been determined by actual weight. A record of the number of scoops was kept by means of counters.

On the consolidations a No. 5 scoop was used, the average weight of the scoopful being 17½ lbs.; while the Mikados were fired with a No. 3 scoop, the average weight being 14½ lbs. This is reflected in the results given below in which the difference in the amount of coal burned per trip is much greater than the difference in the number of scoops shoveled. Two

TABLE NO. 3.

COMPARATIVE AVERAGE RESULTS ON HEAVY GRADES.
Cleveland to Wayland (Eastbound).

Type.	2-8-0.	2-8-2.	Per cent. Difference.
Distance, miles	14	14	....
Running time, minutes	80	79	....
Speed, miles per hour	10.4	10.6	....
Tonnage behind tender	2,145	2,550	18.7
Coal fired, pounds	4,687	4,462	4.8
Pounds of coal per 1,000 ton-miles (exclusive of engine and tender)	156	125	20.

firemen were used on the consolidations, which is the regular practice, while one fireman handled the Mikados.

The weight of water per inch of depth in the tanks was accurately determined and the water level measured through the manhole.

No attempt was made to surround the tests with special conditions. On every run, both the locomotives and the crew operating them were those assigned in the regular course. A

good quality of coal and of the same grade was used on all the runs.

Table No. 1 gives separately a summary of the average results of the westbound and eastbound trips; also the percentage difference. It will be observed that the Mikados made a decidedly better performance in tonnage handled and consumption of coal. They showed up splendidly in the test, steamed freely and handled the train perfectly at all times. They burned from 19 to 21 per cent. less coal per trip than the lighter consolidations, and they hauled from 11 to 16 per cent. heavier trains. Westbound there was little difference in the total time, running time and speed between the two classes of engines, though the Mikados averaged 40 minutes less delayed time. Eastbound the Mikados took their heavier trains over the road in considerably faster time than the consolidations.

On the westbound trips, the solid train was taken through from terminal to terminal in all cases; but, eastbound, cars were switched off and taken up at various points en route. The work done per trip by the locomotives is consequently expressed in each case in ton-miles. It is interesting to compare the performance of the two classes of locomotives over particular portions of the division showing their relative merits under varying grade conditions.

Table No. 2 gives a summary of the comparative performance of the two classes westbound between Elmira and Wayland, a distance of 62½ miles. From the profile it will be seen that most of this distance is an easy ascent averaging about .2 per cent. with some short down grades and level stretches. Under these conditions the Mikados hauled a 11 per cent. heavier train at 21½ per cent. higher speed and burned 23½ per cent. less coal. This gives an average saving of 39 per cent. per 1,000 ton-miles.

TABLE NO. 4.

COMPARISON OF PRINCIPAL DIMENSIONS.

Type.	2-8-2.	2-8-0.
Cylinders, diam. and stroke, in.	28 × 30	26 × 30
Driving wheels, diam. in.	63	57
Boiler, outside diam., front end, in.	86⅛	81½
Boiler pressure, lbs.	180	170
Firebox, length, in.	108	111⅛
Firebox, width, in.	84¼	75¼
Tubes, number and diameter	304-2	445-2
Flues, number and diameter	43-5⅜	....
Tubes and flues, length, ft. & in.	21	15-2
Heating surface, tubes, sq. ft.	4,593	3,513
Heating surface, firebox, sq. ft.	261	202
Heating surface, total, sq. ft.	4,854	3,715
Grate area, sq. ft.	63	58.2
Superheating surface, sq. ft.	1,085	....
Weight on driving wheels, lbs.	236,500	210.500
Weight on leading truck, lbs.	27,500	25,500
Weight on trailing truck, lbs.	48,000	....
Weight, total of engine, lbs.	312,000	236,000
Weight of tender, lbs.	159,700	157,300
Wheel-base, driving, ft. & in.	17-0	17-6
Wheel-base, engine, ft. & in.	35-2	26-5
Wheel-base, engine and tender, ft. & in.	67-3½	60-11
Maximum tractive effort. lbs.	57.100	51,400

A comparison of the performance of the two classes of locomotives under heavy grade conditions is shown in Table No. 3, which gives the average results running from Groveland to Wayland, a distance of 14 miles, all but two miles of which is an ascending grade averaging 1.09 per cent.. Consolidations were used as helpers on this grade for both classes of locomotives. It will be seen that under these conditions the Mikados hauled 18 per cent. more tonnage than the consolidation at the same speed, and burned a little less coal. The Mikados showed a saving of 20 per cent. in coal per 1,000 ton-miles.

As a result of the introduction of the new engines, helper service on the Groveland grade has been reduced, and three of the helpers formerly used have been released for road service.

The Mikados are equipped with superheaters having 1,085 sq. ft. of heating surface, as well as brick arches. The consolidations have neither superheaters nor brick arches, and as far as details and general design are concerned, represent, in the main, the common conventional practice for locomotives of their type.

A comparison of the principal dimensions of the two classes of engines is given in Table No. 4.

EXHAUST VENTILATOR

A new type of ventilator, designed to exhaust air from buildings, has been placed on the market by Paul Dickinson, Inc., Chicago, and is called the Dickinson Aeolus ventilator. The suction in the main flue or pipe is caused by the deflection of the air currents in the outside flues. The air currents passing upwardly in these suction flues create a positive draft in the flue or pipe in passing over the top edge of the pipe. The flues are six in number, and as can be seen from the illustration, are rectangular in form. By maikng the flues rectangular, and by leaving the spaces in between them open, a greater suction is created by the moving air currents. These principles and facts were developed from tests.

In order to get the maximum amount of efficiency from employees, it is necessary to furnish them with the best air obtainable, and to do this at a minimum cost and up-keep a good ventilator is necessary. These ventilators in addition to being made of any sheet metal, are also made in cast iron, where conditions require that material of extreme durability be used.

Dickinson Aeolus Ventilator for Buildings.

ROLLS FOR RECLAIMING SCRAP IRON

It is the custom of most roads to carefully go over the scrap pile and recover usable material, but even when this is most carefully done there is much metal sold as scrap which could be made usuable with the proper facilities. Instances are not infrequent where scrap material has been drawn down under a hammer to a size desired, or even in some cases turned down in a lathe and thus saved, but at a very high cost which would not be justified except for emergencies.

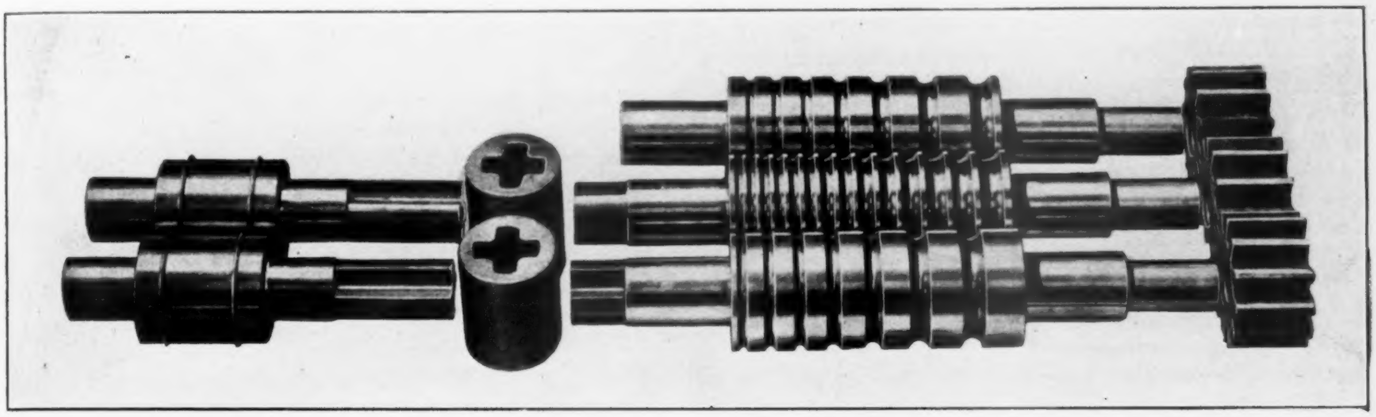
For the purpose of making practically all scrap bars or plates again usable, the Ajax Manufacturing Company, Cleveland, Ohio, has for a number of years been experimenting with a small set of rolls and has now perfected a machine which will handle from four to ten tons of metal a day. With this, bars 2 in. in diameter, or less, can be drawn down to and including ½ in. in diameter, or any intermediate size, and by installing another set of rolls flat or square pieces of the same relative size can be handled.

A pair of splitting rolls are included with the machine which will permit the splitting of very wide pieces to dimensions that can be handled by the rolls.

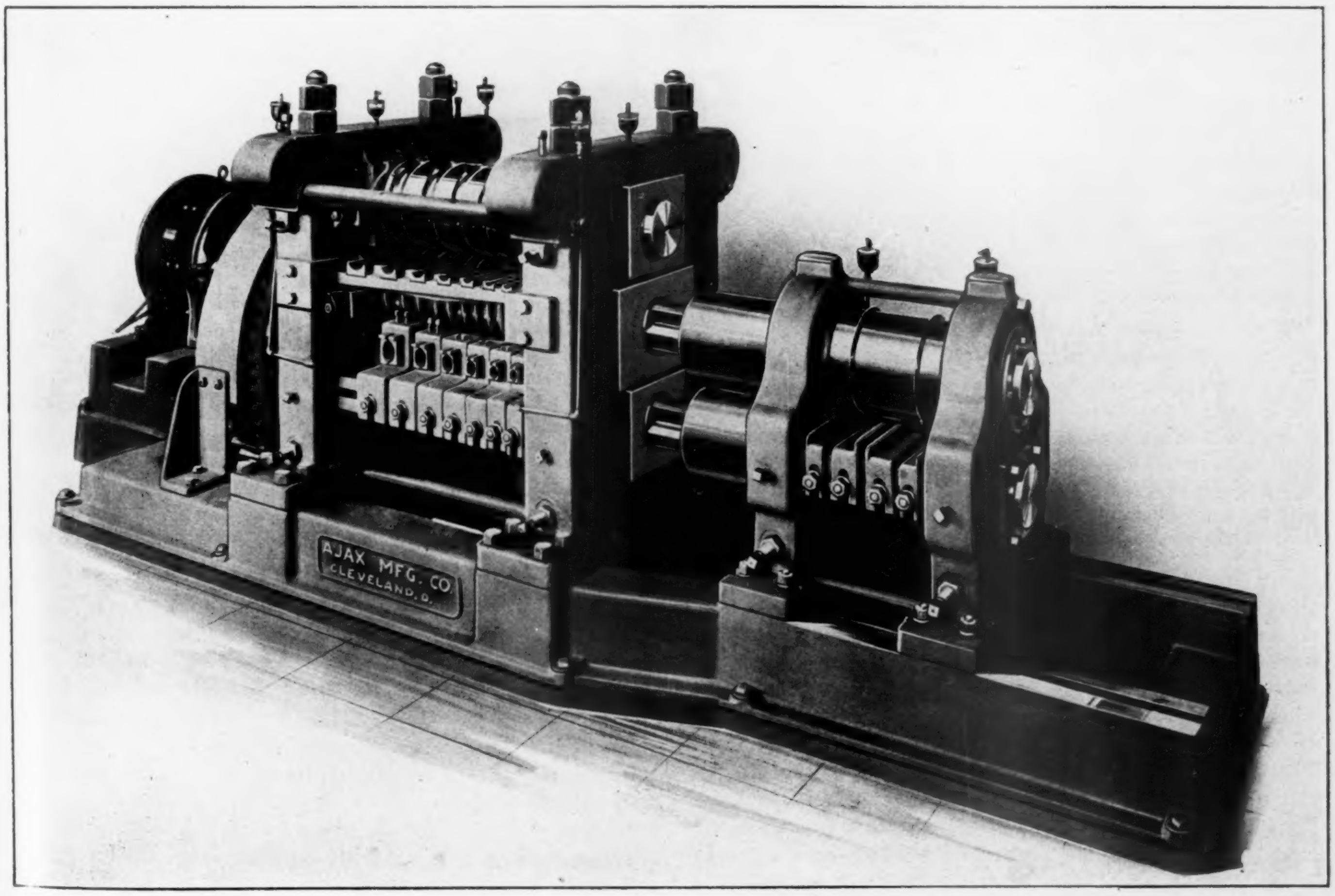
This machine is of the three-roll-high type and is made in several sizes, the standard machine handling the sizes of material mentioned above. It is massive in its construction and arranged for full adjustment both vertically and laterally. The rolls are of a special steel best suited to the work of rolling hot metal, and are carried in large bearings which are bushed with phosphor bronze. This machine can be furnished either belt or motor driven, in the former case requiring from twenty to forty horse power, but in the latter case a fifty horse power motor is recommended. The rolls have a peripheral speed of about 300 ft. per minute.

The scrap bars are ordinarily cut in lengths varying from 2 to 5 ft. long, depending on the section, the larger the bar the shorter the length to which it is cut. These are heated in a suitable furnace and are started through the rolls, the first pass reducing the bar to an eliptical shape and the return pass again reducing it to a round. The process is repeated down the roll until the stock is reduced to the size desired. A complete set of in and out guides are provided making the operation of handling the stock very simple. A crew of four or five men consisting of one roller, an assistant roller, a heater, a helper and a man to carry the re-rolled bars to the cooling table is generally required. For a production of from six to eight tons per day, it is stated that the fuel cost will average only about $6.

Rolls of this design are already in successful use in the shops of a number of the larger railway systems.



Three Rolls for Rerolling Scrap Iron to Round Bars of Any Size. The Splitting Rolls Are Shown at the Left.



Ajax Reclaiming Rolls for Rerolling Scrap Iron.

GENERAL NEWS

An appeal has been made to the State Department at Washington by the Southern Pacific for the protection of its employees and property in Mexico.

The United States Civil Service Commission announces that the examination for engineer draftsman which had been appointed for September 11, has been postponed to October 16 and 17.

H. G. Askew, statistician for the Texas railways, has issued a statement showing that during the fiscal year 1912 these roads paid $2,923,944 in settlement of damages for personal injury, an increase of $420,114 over the previous year.

The executive committee and the arbitration committee of the Master Car Builders' Association recommend the elimination of the penalization feature of the interchange rules and the addition of a fixed percentage to the bills for repairing cars which the using company renders to the car owners.

The Canadian Pacific, acting on the appeal of its telegraphers, following the recent decision by a government board, has agreed to increase their pay 12 per cent. and to make the work day ten hours instead of eleven. There will also be an increase in the rate of pay for overtime. The operators had demanded 15 per cent. increase.

All passenger trains on the Pennsylvania have been limited to a speed of 70 miles per hour at all times. This applies to the lines both east and west of Pittsburgh. Very few schedules call for speeds higher than this and the order will, therefore, not materially affect the present trains except when they are trying to make up lost time.

The General Electric Company has adopted a pension plan similar to those in force on a number of railways; namely, one per cent. of the average pay for ten years multiplied by the number of years in service. The men will be compelled to retire at 70 years and the women at 60 years, with a conditional limit of 65 years for men and 55 for women. No pension will exceed $125 a month.

The sixth annual meeting and dinner of the Veteran Association of the New York, Chicago & St. Louis was held in Chicago, September 7, with about 300 employees in attendance. The association is composed of men who have been in the service of this road 25 consecutive years or more and it has a total membership of about 400, ranking from the general manager down to the shop and track employees.

A train of three electric cars propelled by power from Edison storage batteries was run over the Long Island Railroad last week from the Pennsylvania station, Manhattan, to Long Beach and back, carrying a party of guests. These cars have been built under the direction of R. H. Beach for the United Railway of Havana, Cuba. The cars weigh 39,000 lbs. each and have fixed axles. There are 200 battery cells in each car.

A commemorative medal was awarded to the Chicago & North Western by the International Exposition of Hygiene, for the exhibit at Dresden, in 1911, as displayed and interpreted by the American Museum of Safety. The exhibit illustrated the methods of the safety committee system, which was first introduced on railways by the Chicago & North Western in 1910, and which has since been largely adopted by the railways of this country.

A labor bureau has been established on the Baltimore & Ohio at Baltimore, Md., for the purpose of securing both skilled and unskilled labor for all departments of railway service. H. R. Bricker, labor agent, is in charge of the bureau and branch offices will be established at Philadelphia, Washington, Cincinnati, Cleveland and Chicago. The bureau has no connection with any contract labor system and no charge will be made for the services performed.

An important saving in the amount of payments for fire losses along its right of way is reported by the Atchison, Topeka & Santa Fe as the result of a special campaign for improvement in this respect. In 1910 the company had claims for 1,509 fire losses, amounting to $100,605. In 1911 there were 574 fires with claims amounting to $51,000. In the fiscal year 1912 the number of fires had been reduced to 135, and the expenditure for the payment of claims to only $6,000.

The Pennsylvania has 612 locomotives that are equipped with pumps and hose for extinguishing fires. During the past four years this apparatus has been used 153 times. The original equipment, which consisted of a hose connection placed in the branch pipe between the injector and the boiler, has been replaced by a special form of extinguisher by which the water is taken directly from the tender and is discharged through an ejector, whereby the high pressure steam from the boiler may be used at its best advantage. Each engine is equipped with 150 ft. of 2½-in. hose and a 15-in. cast iron nozzle with a discharge opening of ⅝ of an inch. With this equipment the engine can throw a stream of water 70 ft.

The council of the Verein Deutscher Ingenieure has invited the American Society of Mechanical Engineers to hold a joint meeting with them at Leipzig, Germany, June 23-25, 1913. The meeting is to be followed by an official tour of the industrial centers in Germany and will include a trip on the Rhine and special opportunities for a comprehensive study of the great Museum of the Technical Arts and Industries at Munich. Many establishments will be thrown open that could not be visited under other auspices, and extraordinary and unique opportunities will be afforded to the visitors to familiarize themselves with the latest developments in the various industries. In addition to these visits, which will be a part of the official tour, the society is in receipt of invitations from individual firms throughout Germany. It is hoped that a party may be arranged sufficiently large to warrant chartering an entire steamer.

The "Safety Rally" that was to be held in Kansas City, Mo., September 14, as was mentioned in the August issue of the *American Engineer,* has been postponed to Saturday evening, October 19. The Santa Fe is planning to run excursion trains from several points on their lines. The meeting has been widely advertised throughout the vicinity by posters, and it is expected that the meeting will be the largest and most enthusiastic ever held in the interest of the safety of railway employees. C. W. Kouns will preside at the meeting, and addresses will be made by General Manager Tyler of the Frisco and R. C. Richards, general claim agent and chairman of the central safety committee of the Chicago & North Western. It is also proposed to have employees of different roads give three to five minute talks on their ideas of the effectiveness of personal injury reduction by the individual efforts of the employees in co-operation with the railways. C. W. Egan, general claim agent of the Baltimore & Ohio, and L. F. Shedd, general safety supervisor of the Chicago, Rock Island & Pacific, will also exhibit a large number of moving pictures, illustrating the safe and unsafe ways of doing various kinds of railway work.

SHOP CONTROVERSY SETTLED ON THE ALTON

President B. A. Worthington of the Chicago & Alton has recently settled a controversy with the company's shop employees at Bloomington, Ill., which for a time appeared to present serious aspects. Nine employees of the boiler shop decided they could no longer afford to pay the union dues and dropped their membership, whereupon the organization petitioned the management to discharge the men unless they returned to the union. The company took the position that the matter was one for the union

to settle itself without interference by the management and the case had been submitted to the officers of the shop federation when President Worthington called a mass-meeting of the employees at Bloomington and went there to address them.

Mr. Worthington began by explaining that one of the first problems presented to him on assuming the presidency of the road was to take care of the deferred maintenance of equipment, amounting to about $500,000, and that his first idea was to have the work done in outside commercial shops in order to get the deferred work done as quickly as possible without interfering with current repairs. His attention having been called, however, to the fact that the shops at Bloomington had been closed for several months previously, he decided that it would be to the advantage of the employees and to the town if this money, 60 per cent. of which would take the form of wages for labor, were spent in having the work done at Bloomington. It developed that there was a shortage of machinists and the company secured 50 machinists from an employment agency at Cleveland. Mr. Worthington said that these men were engaged without reference to whether or not they were union men, and he discussed the entire situation with general reference to the relations between capital and labor in a frank and informal way, finally asking for a rising vote of the men as to whether they preferred to have the locomotives and cars taken from the Bloomington shops and repaired in outside shops or to have the half million dollars spent in Bloomington. Practically all those at the meeting stood up, signifying their preference for the latter. In a conference later with the federation committee Mr. Worthington declined interference with the matter and the question was soon dropped.

CHICAGO & ALTON'S FUEL CAMPAIGN

The Chicago & Alton has made arrangements to carry on a fuel economy campaign which will be under the jurisdiction of George H. Baker, president of the Railway Educational Association of New York. Mr. Baker will devote 75 per cent. of his time to this work without compensation, believing that the effect of a campaign of this sort on his association will warrant the giving of his services free. He will travel about the road in a car especially fitted up for his use by the road, giving lectures and practical talks to the men at the engine terminal points. There will be two practical assistants who have previously fired on the road, and who will ride the engines, giving the firemen practical demonstrations of the methods to be followed. Mr. Baker will issue a book of instructions to be distributed to the men having anything to do with the handling of fuel. Bulletins have also been sent out by J. T. McGrath, superintendent of rolling stock, calling the attention of all the employees to the following points:

The loading of engine tanks so that the coal will not be wasted by being scattered over the road, the prompt housing of engines at terminals, the conservative firing of the coal, working the engine at the shortest cut-off practicable, the economical use of the injector, the waste due to the blowing of safety valves, and the fundamental principles of combustion. This bulletin is to be displayed at all the engine houses, and is especially addressed to engine house foremen, engineers, firemen and hostlers. Mr. Baker served the Chicago & Alton as a fireman, and the Wabash as an engineer, and since then has devoted considerable of his time to the study and investigation of fuel economy on locomotives. By this campaign he expects to decrease the Chicago & Alton's fuel bill by more than $100,000 annually.

The road, in connection with this work, has issued the following statement: "The cost of fuel is the chief operating expense of this company and exceeds $1,100,000 annually. This expense can be reduced by efforts of employees to economize and avoid waste. The management looks to the locomotive engineers and firemen for the greatest saving of fuel, and other employees, by their co-operation, also can assist."

MEETINGS AND CONVENTIONS

National Machine Tool Builders' Association.—The fall convention will be held at the Hotel Astor, New York City, October 16-18.

St. Louis Railway Club.—The first regular meeting of the St. Louis Railway Club for the fall season was held Friday evening, September 13, at the Mercantile Club building, St. Louis. Samuel O. Dunn, editor of the *Railway Age Gazette*, delivered an address on Government Regulation of Railway Operation.

Western Railway Club.—G. W. Cravens, president of the Cravens Electric Company, Chicago, read a paper at the September 17 meeting on the subject of electrical equipment of railway shops. It discussed briefly the general features of design of a railway repair shop and the characteristic features of the electrical equipment.

International Association for Testing Materials.—The sixth congress of this association was held in the Engineering Societies building, New York, from September 3 to 7. The association now numbers about 2,400 members, distributed in one hundred and thirty different countries. There are 472 members in the United States. The total registration at the congress was about 650, of which 75 were ladies. Among the many papers presented to the congress, those of especial interest to the railways included seven on the subject of rails; also on the subjects of hardness, testing and wear, test of wear of steels, hardness of steel, testing steel tubes, and welding steel.

Northern Railway Club.—At the July meeting a paper on the Automatic Train Pipe Coupler Problem was presented, and will be discussed at a later meeting. The author briefly reviewed the history of the development of automatic connectors, and concluded by stating that in his opinion there are four essential requirements for a successful connector: First, there shall be no spring mechanism. Second, that coupler heads do not extend beyond the face of the knuckle. Third, there should be an arrangement permitting the attachment of an ordinary hose if necessary. Fourth, the angle cock should be dispensed with.

New York Railroad Club.—At the first meeting of the season on September 20, A. W. Whitford presented a paper on the Relation of the Locomotive Boiler Design to Efficiency, Maintenance and Safety. It consisted largely of a discussion of the construction and advantages of the sectional type of firebox as manufactured by the Jacobs-Shupert U. S. Firebox Company, and gave a brief account of some of the results of the comparative tests which were finished at Coatsville last June between a boiler of this type and a standard radial stay boiler. The paper was thoroughly illustrated with lantern slides and moving picture views of the low water tests. In the discussion, S. S. Riegel, mechanical engineer, Delaware, Lackawanna & Western, gave an account of some tests he made several years ago which clearly demonstrated the value of firebox circulation. These were fully described in the June, 1909, issue of the *American Engineer & Railroad Journal*, page 253, and showed an increase of 55 per cent. in the water evaporated from the boiler fitted with a water tube firebox as designed by Mr. Riegel, when compared with the ordinary type of boiler. Representatives of the Lehigh Valley reported that the Jacobs-Shupert boilers in service on that road are giving satisfactory results.

Co-operative Safety Congress.—A Co-operative Safety Congress is to be held at the Hotel Pfister, Milwaukee, Wis., September 30 to October 5. All of Wednesday afternoon October 2, was scheduled as a transportation session, at which R. C. Richards, general claim agent and chairman of the central safety committee of the Chicago & North Western presided as chairman. The speakers included: A. Hunter Boyd, Jr., chair-

man of the general safety committee of the Baltimore & Ohio; H. W. Belnap, chief inspector of safety appliances of the Interstate Commerce Commission; Geo. Bradshaw, general safety agent of the New York Central Lines; S. M. Braden, general superintendent of the Chicago & North Western. Rooms at the hotel were assigned for safety exhibits under the direction of C. W. Price of the Wisconsin Industrial Commission.

Chief Car Inspectors' and Car Foremen's Association.—At the thirteenth annual convention, held in Chicago on August 27, 28 and 29, the following officers were elected: President, J. L. Stark, general car inspector, Hocking Valley, Columbus, Ohio; vice-president, F. C. Schultz, chief interchange inspector, Chicago; secretary, Stephen Skidmore, foreman car department, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio. The sessions of the convention were devoted to a general discussion of the interpretation of the interchange rules of the Master Car Builders' Association.

M. C. B 1913 COMMITTEES

Following is a list of the subjects and the chairmen of committees which will report at the 1913 convention of the Master Car Builders' Association:

STANDING COMMITTEES.

Arbitration, J. J. Hennessey, C. M. & St. P., Milwaukee, Wis.; Revision of Standards and Recommended Practice, T. H. Goodnow, C. & N. W., Chicago, Ill.; Train Brake and Signal Equipment, R. B. Kendig, N. Y. C. Lines, New York City; Brake Shoe and Brake Beam Equipment, Prof. Chas. H. Benjamin, Purdue University, Lafayette, Ind.; Coupler and Draft Equipment, R. L. Kleine, Penna. R. R., Altoona, Pa.; Rules for Loading Material, A. Kearney, N. & W., Roanoke, Va.; Car Wheels, William Garstang, C. C. C. & St. L., Indianapolis, Ind.; Safety Appliances, C. E. Fuller, U. P., Omaha, Neb.

SPECIAL COMMITTEES.

Car Trucks, J. T. Wallis, Penna. R. R., Altoona, Pa.; Prices for Labor and Material, F. H. Clark, B. & O., Baltimore, Md.; Train Lighting and Equipment, T. R. Cook, Penna. Lines, Pittsburgh, Pa.; Train Pipe and Connections for Steam Heat, I. S. Downing, L. S. & M. S., Cleveland, Ohio; Nominations, F. W. Brazier, N. Y. C. & H. R., New York City; Arrangements, C. E. Fuller, U. P., Omaha, Neb.; Tank Cars, A. W. Gibbs, Penna. Lines, Philadelphia, Pa.; Specifications for Tests of Steel Truck Sides and Bolsters for Cars of 80,000, 100,000, 150,000 Lbs. Capacity, Prof. E. C. Schmidt, University of Illinois, Urbana, Ill.; Capacity Marking of Cars, C. E. Fuller, U. P., Omaha, Neb.; Lettering Cars, D. F. Crawford, Penna. Lines, Pittsburgh, Pa.; Damage to Freight Equipment by Unloading Machines, P. F. Smith, Jr., Penna. Lines, Toledo, Ohio; Air Brake Hose Specifications, M. K. Barnum, I. C., Chicago, Ill.; Conference with Association of American Railway Accounting Officers, D. F. Crawford, Penna. Lines, Pittsburgh, Pa.; Revision of Present Specifications, C. D. Young, Penna. R. R., Altoona, Pa.; Car Construction, W. F. Kiesel, Jr., Penna. R. R., Altoona, Pa.

M. M. 1913 COMMITTEES

Following is a list of the subjects which will be reported on and the chairmen of the committees for the 1913 convention of the American Railway Master Mechanics' Association:

STANDING COMMITTEES.

Revision of Standards, W. E. Dunham, C. & N. W., Winona, Minn.; Mechanical Stokers, T. Rumney, C. R. I. & P., Chicago, Ill.

SPECIAL COMMITTEES.

Specifications for Cast-steel Locomotive Frames, C. B. Young, C. B. & Q., Chicago, Ill.; Main and Side Rods, W. F. Kiesel, Jr., Penna. R. R., Altoona, Pa.; Safety Appliances, D. F. Crawford, Penna. Lines West, Pittsburgh, Pa.; Design, Construction and Inspection of Locomotive Boilers, D. R. MacBain, L. S. & M. S., Cleveland, Ohio; Steel Tires, L. R. Johnson, C. P., Montreal, Que., Can.; Minimum Requirements for Headlights, D. F. Crawford, Penna. Lines West, Pittsburgh, Pa.; Standardization of Tinware, A. J. Poole, S. A. L., Portsmouth, Va.; Superheater Locomotives, J. T. Wallis, Penna. R. R., Altoona, Pa.; Subjects, G. W. Wildin, N. Y. N. H. & H., New Haven, Conn.; Specifications for Material Used in Locomotive Construction, H. T. Bentley, C. & N. W., Chicago, Ill.; Use of Special Alloy Steels and Heat-treated Steel in Locomotive Construction, C. D. Young, Penna. R. R., Altoona, Pa.; Smoke Prevention, E. W. Pratt, C. & N. W., Chicago, Ill.; Engine Tender Wheels, William Garstang, C. C. C. & St. L., Indianapolis, Ind.; Arrangement, D. F. Crawford, Penna. Lines West, Pittsburgh, Pa.

INDIVIDUAL PAPERS.

Tests of Superheater Locomotives, by Dean C. H. Benjamin, Purdue University, Lafayette, Ind. Three Cylinder Locomotives, by J. Snowden Bell, New York.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. 1913 convention to be held at St. Louis, Mo.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, McCormick building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, Chicago & North Western, Escanaba, Mich.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

RAILROAD CLUB MEETINGS

CLUB.	NEXT MEETING.	TITLE OF PAPER.	AUTHOR.	SECRETARY.	ADDRESS.
Canadian	Oct. 8	The Car Inspector	L. C. Ord	Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	Nov. 8	Brake Operation on Long Freight Trains.	John P. Kelly	H. D. Vought	95 Liberty St., New York.
New England	Oct. 8	The Story of Brushes and the Material Entering Into Them	Lew C. Hill	Geo. H. Frazier	10 Oliver St., Boston, Mass.
New York	Oct. 18	"Liquid Fuel. Its Use and Abuse in Railroad Shop Practice"	W. N. Best	H. D. Vought	95 Liberty St., New York.
Northern	Oct. 5			C. L. Kennedy	401 Superior St., Duluth, Minn.
Pittsburgh	Oct. 25	Annual Meeting—Election of Officers		J. B. Anderson	Union Station, Pittsburgh Pa.
Richmond	Oct. 11	The Health of Railroad Men	Dr. E. C. Levy	F. O. Robinson	C. & O. Ry., Richmond, Va.
S'th'n & S. West'n				A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
St. Louis	Oct. 18	Prevention of Accidents, Safeguarding Employees, etc.	F. C. Schwerdtmann	B. W. Frauenthal	Union Station, St. Louis, Mo
Western	Oct. 11	Telpherage Systems	H. M. Harding		
	Oct. 15	Tests of Locomotive Headlights	C. M. Larson	Jos. W. Taylor	390 Old Colony Bldg., Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL.

GEORGE H. BAKER has been appointed fuel director in charge of fuel economies on the Chicago & Alton. His efforts will be directed to the reduction of consumption and waste of fuel. From 1879 to 1881 he served as a fireman on the Kansas City division of the Chicago & Alton, and later served six years as engineer on the Wabash. He is president of the Railway Educational Association, with offices in New York.

JOHN BENZIES, smoke inspector of the Rock Island Lines, has been appointed fuel inspector at Chicago, Ill., vice F. Wilson, promoted.

G. H. BUSSING, superintendent of motive power of the New Orleans Great Northern, at Bogalusa, La., having resigned to accept service elsewhere, that position has been abolished.

O. E. GILLILAND has been appointed district safety supervisor, Third District, of the Rock Island Lines, with headquarters at El Reno, Okla.

F. G. GRIMSHAW, master mechanic of the West Jersey & Seashore and the Camden Terminal division of the Pennsylvania Railroad at Camden, N. J., has been appointed assistant engineer of motive power of the Western Pennsylvania division, with office at Pittsburgh, Pa.

A. M. DARLOW, who was recently appointed superintendent of motive power of the Buffalo & Susquehanna Railroad and the Buffalo & Susquehanna Railway Company, served his apprenticeship on the Vandalia Railroad. Later he went to Cornell University and was graduated from there in 1906. He entered the service of the Chicago & Eastern Illinois as a special apprentice and shop draftsman, and in 1910 was made engine-house foreman of the Chicago Terminal of the Chicago & Eastern Illinois at Dalton, Ill. In 1911 he was transferred as engine-house foreman to Danville, Ill. He was appointed mechanical engineer of the Buffalo & Susquehanna in May, 1911, and in April, 1912, he was made general storekeeper as well as mechanical engineer. As superintendent of motive power of this road he has charge of the mechanical and the store departments.

A. M. Darlow.

D. B. LOTHIAN has been appointed district safety inspector of the Rock Island Lines, with headquarters at Topeka, Kans.

J. T. MCGRATH, superintendent rolling stock of the Chicago & Alton, with headquarters at Bloomington, Ill., has resigned, effective October 1, and will be succeeded by J. E. O'Hearne, master mechanic of the Wheeling & Lake Erie.

STANLEY S. WAGAR, whose appointment as chemist and engineer of tests of the Buffalo, Rochester & Pittsburgh, with office at Du Bois, Pa., has been announced in these columns, was born in December, 1886, at Troy, N. Y., and was educated at Rensselaer Polytechnic Institute. He began railway work in May, 1910, with the Union Pacific as material inspector, and from April to September, 1911, was assistant chemist on the Missouri Pacific. He was then with the St. Louis & San Francisco as chemist until August, 1912.

WILLIAM HOLLAND WINTERROWD, who was recently appointed mechanical engineer of the Canadian Pacific, with headquarters at Montreal, Canada, was born April 2, 1884, at Hope, Ind. He attended the public schools at Shelbyville, Ind., and in 1907 was graduated from Purdue University. In 1905 he was employed for a short time as a blacksmith's helper on the Lake Erie & Western, at Lima, Ohio, and in 1906 served as car and air-brake repairman for the Pennsylvania Lines West at Dennison, Ohio. After leaving the university he was employed as a special apprentice on the Lake Shore & Michigan Southern, serving in that capacity until 1908, when he was made engine-house foreman of the Lake Erie, Alliance & Wheeling, at Alliance, Ohio. In 1909 he was made night engine-house foreman of the Lake Shore & Michigan Southern at Youngstown, Ohio, and in 1910 was transferred as engine-house foreman of the same road to Cleveland, Ohio. Later in the year he was promoted to assistant to the mechanical engineer of the Lake Shore, which position he held until he was recently appointed mechanical engineer of the Canadian Pacific.

W. H. Winterrowd.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

JAMES ASHCROFT has been assigned to duty as road foreman on the Grand Trunk Pacific, covering the territory from Transcona to Melville and the Yorkton Branch.

E. J. BRENNAN has been appointed master mechanic of the Du Bois shops of the Buffalo, Rochester & Pittsburgh, with headquarters at Du Bois, Pa.

NEWTON CAGE, assistant road foreman of engines of the Connellsville division of the Baltimore & Ohio, has been promoted to road foreman of engines.

S. J. DILLON, who has been appointed master mechanic of the West Jersey & Seashore, and the Camden Terminal division of the Pennsylvania Railroad, with headquarters at Camden, N. J., as announced in our September issue, was born near Hollidaysburg, Pa., on April 15, 1862. He was educated in the Altoona public schools, also at Professor Davis' Business College, and took a special course in mechanical drawing. On September 1, 1879, he entered the service of the Pennsylvania Railroad as a helper and messenger in the Altoona machine shops and has been in the continuous service of that company ever since. In March, 1881, he was made machinist's apprentice, becoming machinist at the Altoona machine shops in May, 1885. He was transferred to the test department on April 1, 1892. In November, 1895, he was appointed assistant engine-house foreman of the New York division at Jersey City, N. J., and was promoted to foreman of the locomotive department of the Meadows shops,

New York division, on January 1, 1898, He was appointed general foreman of passenger-car inspectors of the New York division, with headquarters at Jersey City, in December, 1898, and was made master mechanic of the South Amboy division on December 1, 1902. In April, 1908, he was appointed division master mechanic of the Amboy division with headquarters at Camden.

J. S. Golithon has been appointed master mechanic of the Bellingham Bay & British Columbia, with office at Bellingham, Wash., succeeding J. A. Haley, resigned.

J. P. Kendrick has been appointed master mechanic of the Middle and Pittsburgh divisions of the Buffalo, Rochester & Pittsburgh, with headquarters at Punxsutawney, Pa.

C. E. Langton has been appointed master mechanic of the Marshall & East Texas, succeeding F. A. Walsh, resigned to engage in other business.

J. P. Loux, assistant master mechanic of the N. J. & L. division of the Lehigh Valley, has been appointed master mechanic of the M. & H. division, at Hazelton, Pa., succeeding T. H. Malican, resigned.

M. F. McCarra has been appointed master mechanic in charge of all equipment of the Louisiana Railway & Navigation Company, with office at Shreveport, La., succeeding T. Nicholson, resigned.

B. H. Miller, an engineer on the Connellsville division of the Baltimore & Ohio, has been promoted to assistant road foreman of engines. His headquarters will be at Rockwood, Pa.

W. E. Moher, road foreman of engines of the Grand Trunk Pacific, will hereafter devote his attention to the Regina Branch and to the Third District, Melville to Watrous.

H. J. Osborne has been appointed master mechanic of the Louisiana division of the Rock Island Lines, with headquarters at Eldorado, Ark., succeeding W. F. Moran, transferred.

C. D. Smith has been appointed road foreman of the Grand Trunk Pacific, covering the territory from Watrous to Biggar, including the Oban-Battleford and Biggar Calgary branches; he will report to J. R. Mooney, at Wainwright, Alberta.

A. K. Stanley has been appointed master mechanic of the Houston & Texas Central, at Sherman, Tex.

W. H. Williams, master mechanic of the Buffalo, Rochester & Pittsburgh, at Du Bois, Pa., has been appointed master mechanic of the Buffalo & Rochester divisions, with headquarters at East Salamanca, N. Y., succeeding P. C. Zang, resigned.

F. Wilson, fuel inspector of the Rock Island Lines, has been appointed road foreman of equipment, with headquarters at Cedar Rapids, Iowa.

A. S. Wright has been appointed locomotive foreman on the Grand Trunk Pacific at Regina, vice A. J. Roberts, resigned.

CAR DEPARTMENT

W. O. Anker has been appointed day coach yard foreman of the Rock Island Lines, with headquarters at Valley Junction, Iowa, vice John Swival, transferred.

J. P. Brendel, foreman of the cabinet shop of the Southern Pacific, has been appointed assistant general foreman of the car department, with headquarters at Sacramento, Cal.

W. S. Buckler, assistant foreman of the Southern Pacific, has been appointed foreman of the cabinet shop, with headquarters at Sacramento, Cal.

R. A. Fitz, foreman of the Lake Shore & Michigan Southern at 26th street, Cleveland, Ohio, has been appointed foreman of freight repairs, with headquarters at Nottingham, Ohio.

G. H. Hopper, foreman of the Lake Shore & Michigan Southern, at Youngstown, Ohio, has been appointed foreman of the car department of the Lake Front shop at Sandusky, Ohio.

F. A. Isaminger has been appointed chief car inspector of the Trinity & Brazos Valley, with headquarters at Teague, Tex., vice A. K. Stanley, promoted.

T. H. Klunder has been appointed night coach yard foreman of the Rock Island Lines, at Valley Junction, Iowa.

S. Lindman, foreman of freight repairs of the Lake Shore & Michigan Southern, at Nottingham, Ohio, has been appointed foreman of the car department, with headquarters at Youngstown, Ohio.

L. J. Wilson has been appointed acting car foreman of the Rock Island Lines at Armourdale, Kans., vice William Bonner, resigned.

SHOP AND ENGINE HOUSE

R. Benedict, erecting foreman of the Atchison, Topeka & Santa Fe, at Richmond, Cal., has been appointed roundhouse foreman, with headquarters at Bakersfield, Cal.

J. W. Brewer has been appointed superintendent of the Mount Clare, Baltimore, Md., shops of the Baltimore & Ohio. He was born September 6, 1880, at Grafton, W. Va., and began railway work on September 24, 1895, as an engine cleaner on the Baltimore & Ohio, and has been in the service of that road ever since. From November, 1896, to November, 1900, he was machinist's apprentice, and in November, 1900, was appointed machinist. Three years later he was made roundhouse foreman, and in 1904, was appointed gang foreman of the erecting shop. He was promoted in 1907 to erecting-shop foreman. In 1908 he was appointed assistant master mechanic, and two years later he was made master mechanic, which position he held at the time of his recent promotion as superintendent of shops, as above noted. He will also perform the duties of master mechanic as heretofore. The Mount Clare shops are the principal ones on the Baltimore & Ohio system. Most all of the heavy repair work to locomotives and cars, from all lines, is done at Mount Clare, and about 3,000 skilled mechanics and shopmen of various grades are steadily employed there.

J. R. Cook has been appointed general foreman of the Atchison, Topeka & Santa Fe, at Clovis, N. M., vice O. V. Morrison, resigned.

W. F. Crosby, boilermaker of the Central Vermont, has been appointed foreman boilermaker, with headquarters at St. Albans, Vt.

Charles H. Douglass, boilermaker of the Central Vermont, has been appointed boiler inspector, with headquarters at St. Albans, Vt.

W. J. Dovitt has been appointed roundhouse foreman of the Rock Island, with headquarters at McFarland, Kans., vice F. L. Coles, promoted.

I. H. Drake, machine-shop foreman of the Atchison, Topeka & Santa Fe at Cleburne, Tex., has been appointed general foreman at Raton, N. M.

C. E. Egan has been appointed general foreman of the Missouri, Kansas & Texas at Waco, Tex.

G. I. Evans has been appointed superintendent of locomotive shops of the Canadian Pacific, at Angus, Montreal, Que. He was born in May, 1880, at Montreal. He began railway work on April 1, 1900, with the Canadian Pacific as a draftsman, remaining in that position until March, 1906, when he was promoted to chief draftsman. In July, 1910, he was appointed mechanical engineer of the Canadian Pacific, which position he held at the time of his appointment as superintendent of shops.

R. T. Gorman has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, at Needles, Cal., vice E. W. Tucker, transferred.

G. E. Johnson has been appointed division foreman of the Atchison, Topeka & Santa Fe, at Gallup, N. M., vice E. M. Sanjule, promoted.

Rance Johnson, boilermaker of the Atchison, Topeka & Santa Fe, has been appointed foreman boilermaker, with headquarters at La Junta, Colo.

J. Z. Kuhns has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., vice J. R. Cook, promoted.

C. E. Lindeman, apprentice instructor of the Atchison, Topeka & Santa Fe, at Richmond, Cal., has been apopinted machine foreman at La Junta, Colo.

W. B. Lyons, machinist of the Atchison, Topeka & Santa Fe, at Richmond, Cal., has been appointed machine foreman, at Bakersfield, Cal.

A. G. McDougal has been appointed boiler-shop foreman of the Denver & Rio Grande, with headquarters at Salt Lake City, Utah.

W. Murphy has been appointed night engine-house foreman of the Missouri, Kansas & Texas, at Dallas, Tex., vice E. Owens, promoted.

E. Owens, night engine-house foreman of the Missouri, Kansas & Texas, at Dallas, Tex., has been appointed general foreman of the same road, at Gainesville, Tex.

T. T. Ryan has been appointed assistant engine-house foreman of the Atchison, Topeka & Santa Fe at Raton, N. M.

E. M. Sanjule, division foreman of the Atchison, Topeka & Santa Fe, at Gallup, N. M., has been appointed general foreman, with headquarters at Riverbank, Cal.

William Sapp has been appointed night roundhouse foreman of the Atchison, Topeka & Santa Fe, with headquarters at Sweetwater, vice J. A. Whithurst, resigned.

R. T. Shea, general inspector of shops of the New York Central & Hudson River, at New York, resigned recently.

J. A. Whithurst, night roundhouse foreman of the Atchison, Topeka & Santa Fe, at Sweetwater, has been appointed general foreman of the Orient Railway, at San Angelo, Tex.

PURCHASING AND STOREKEEPING

W. A. Gillespie has been appointed storekeeper of the Frisco Lines, with headquarters at De Quincey, La., vice Neal Cavin, resigned.

J. H. Hollub has been appointed assistant to the superintendent of stores of the National Railways of Mexico, with headquarters at San Luis Potosi, Mex.

F. S. Hubbard has been appointed traveling storekeeper of the Lake Shore & Michigan Southern, with headquarters at Collinwood, Ohio.

L. J. McHugh has been appointed storekeeper of the Lake Shore & Michigan Southern at Air Line Junction, Ohio, vice F. S. Hubbard, promoted.

J. M. Velasco has been appointed storekeeper of the San Luis Potosi division of the National Railways of Mexico, with headquarters at San Luis Potosi, Mex., vice G. Rios del Rio, who has resumed his duties as storekeeper of the Chihuahua division, with headquarters at Chihuahua, Mex.

W. L. Wene, purchasing agent of the Tennessee Central, at Nashville, Tenn., has resigned, and the position has been abolished. The duties of purchasing agent have been assumed by the president.

NEW SHOPS

Atchison, Topeka & Santa Fe.—A new machine shop and an engine house will be built at Winslow, Ariz.

Chicago, Milwaukee & St. Paul.—A 40-stall engine house will be built at Sioux City, Iowa, and the car shops will be enlarged.

Chicago, Peoria & St. Louis.—Car shops will be erected at Springfield, Ill., at a cost of $60,000.

Chicago, Rock Island & Pacific.—A one-story 20-stall engine house will be built at Manley Junction, Ill.

Chicago & North Western.—The report for the year ended June 30, 1912, shows that the terminal facilities at Proviso, Ill., have been enlarged and improved by the construction of a 58-stall, 90-ft., brick engine house, a machine shop, a power house and other buildings. At Boone, Ia., a 36-stall, 90-ft., brick engine house, a power house, a machine shop and miscellaneous buildings have also been completed. At the Chicago shop plant, a brick extension to the power house, 108 ft. x 30 ft., has been built.

Chicago, St. Paul, Minneapolis & Omaha.—The report for the year ended June 30, 1912, shows that an engine house, a machine shop and oil house were built at Omaha, Neb., jointly with the Chicago & North Western, and additions were made to the machine shop at St. Paul, Minn. Work was started grading north of Twentieth avenue, North, Minneapolis, Minn., for putting up a 30-stall engine house with turntable, heating plant, etc., connected with a building for machine shop, boiler room and coaling station.

Cleveland, Cincinnati, Chicago & St. Louis.—Additions will be made to the repair shops at Springfield, Ohio. The contract has been awarded to Lauderbach & Sieverling, Springfield. The contract for the engine house at Elkhart, Ind., has been awarded to H. A. Peters Company, Chicago. Additional shops will be built at Beech Grove, Ind., at an estimated cost of $175,000.

Great Eastern Lumber Company.—This concern is building seven miles of railway near Savannah, Ga., and will build an engine house and repair shop.

Illinois Central.—The machine shops at Jackson, Tenn., were damaged by fire on September 7 to the extent of $40,000. They will be rebuilt at once.

Manufacturers' Railway.—Bids have been received for an engine house and machine shop, 80 x 390 ft., of concrete and steel construction, to be erected at St. Louis, Mo.

Michigan Central.—The new engine house that is being built at Bay City, Mich., will contain 40 stalls instead of 30, as previously stated, and the capacity of the machine shops will be increased about one-third over the original plans.

Minneapolis & St. Louis.—A 15-stall engine house constructed of concrete and steel will be built at Oskaloosa, Iowa. One of the stalls will be used as a boiler room and another as a machine shop.

Missouri, Kansas & Texas.—The building of the car repair shops at East Waco, Tex., will be started in a short time, and a water-treating plant will be built at Waco at a cost of about $75,000.

Missouri Pacific.—The annual report for the year ended June 30, 1912, shows that during the year a new 95-ft. brick, 27-stall engine house, with machine shop, was built at Argenta, Ark. The extensive shop buildings were completed at Hoisington, Kan.; at Falls City, Neb., and at East Bottoms (Kansas City), Mo.

New Orleans Terminal Company.—An engine house will be built at New Orleans, La., to meet the demands of the Frisco and Southern railways.

New York, New Haven & Hartford.—A 30-stall engine house will be built at Mansfield, Mass., to be used in connection with the proposed electric train service between Boston, Mass., and Providence, R. I.

Norfolk & Western.—The contracts for a new engine house and shop buildings at Lamberts Point, Va., have been awarded to John P. Pettyjohn & Co., Lynchburg, Va. The work is now under way.

Pennsylvania Railroad.—Plans have been made for putting up new rest houses at Sunnyside yard, Long Island City, at the Pennsylvania station in New York City, and at Waverly Transfer, N. J. A two-story brick building, 40 ft. x 66 ft., is to be built at the Sunnnyside yard. It will have a lunch room and kitchen on the first floor, and the second floor will be used for lockers and sleeping rooms. A two-story brick structure will be put up at the New York terminal. It will have lunch and locker rooms. A one-story building is to be built at Waverly Transfer.

Pennsylvania Railroad.—The contract for the erection of a 36-stall engine house at Indianapolis has been awarded to the Whitherspoon-Enger Company, Chicago.

Southern Pacific.—The plans for the construction of new machine shops at South Portland, Ore., have been approved. The total cost will be about $200,000. The work has begun on the enlargement of the shops at Tuscon, Ariz. The main building will be 100 ft. x 200 ft., and will be equipped for handling repairs to the largest locomotives. The plans also provide for a 350,000-gal. tank.

Union Pacific.—It is reported that a 28-stall engine house, a coaling station, water tank, etc, will be built at North Platte, Neb., during the present fiscal year.

Wabash.—The construction work on the new locomotive repair shops at Decatur, Ill., has been awarded to the Decatur Bridge Company.

Anthracite Coal in Pennsylvania.—According to a statement issued by the United States Geological Survey, the output of anthracite coal in Pennsylvania during 1911 was 80,732,000 gross tons, which have a value of $175,853,000. This surpasses the previous record by 4,700,000 tons.

Coal Production in the United States.—The United States Geological Survey has issued statistics which show that the total production of coal in the year 1911 was 496,188,308 short tons, which had a value at the mines of $625,910,115. This is a decrease from 1910 of 5,408,070 tons, the decrease being attributed wholly to the depressed condition of the iron and steel trade during the year.

Chilean Government Railway Statistics.—In 1901 the Chilean government railways had in use 292 locomotives, 4,057 freight cars, and 323 passenger coaches, while in 1911 the numbers were 633 locomotives, 7,194 freight cars, and 452 passenger coaches. The receipts of the lines increased in the decade from $5,360,520 to $11,513,040, while the operating expenses increased from $6,177,270 to $14,132,078.

An Improved Road Roller.—A steam road roller has been built by Ruston, Prostor & Company, Ltd., Lincoln, England, which uses superheated steam and is equipped with a feed-water heater. It weighs 12 tons, and is geared to run at 1½ and 3 miles an hour. The superheater coils are placed in front of the boiler flues in the smoke box and the feed water heater is placed in the exhaust pipe, and performs a dual service, that of heating the feed water and of muffling the exhaust.

Supply Trade Notes

The Keith Car Company, Chicago, has increased its capital stock from $30,000 to $100,000.

J. McKay Duncan has been appointed sales manager of the Westinghouse Electric & Manufacturing Company for the Pittsburgh district, vice W. F. Fowler, resigned.

The Jeffrey Manufacturing Company, Columbus, Ohio, has removed its branch office at Chicago to the seventeenth floor of the McCormick building on Michigan avenue.

The management of the Preston Car & Coach Company, Preston, Ont., has secured the Canadian manufacturing rights of the gasolene-electric cars recently tried out on the Canadian Northern.

The Pratt & Whitney Company, New York, has opened an office and salesroom for small tools and gages at 336 West Fourth street, Cincinnati, Ohio. The new office will be in charge of C. M. Pond.

Frank G. Wright, formerly works manager at the Indiana Harbor plant of the American Steel Foundries, has been appointed general manager of the Ohio Steel Foundry Company, Lima, Ohio.

Joseph T. Markham, for several years general sales agent of the Sellers Manufacturing Company, Chicago, has been made vice-president of the St. Louis Car Wheel Company, with headquarters in St. Louis.

The wages of the laborers of the Bethlehem Steel Company, South Bethlehem, Pa., have been increased from 13½ cents an hour to 14½ cents an hour. About 3,000 men will be affected by this change.

Henry C. King, treasurer of the American Safety Tread Company, Lowell, Mass., has been made president and general manager of that company, succeeding William S. Lamson, who died at his home in Lowell on August 16.

The Canadian Locomotive Company, Ltd., Kingston, Ont., which has been increasing the capacity of its plant from five to 18 locomotives per month, has orders on hand for enough locomotives to keep the plant running at full capacity for the next 12 months.

The Pilliod Company, New York, during June, July and August, received orders for as much new business as during the entire fiscal year ended May 31, 1912. Additions being made to the plant at Swanton, Ohio, will increase the capacity by 66 2-3 per cent., and are now nearly completed.

The Kerr Turbine Company, Wellsville, N. Y., has found it necessary to open an office in Pittsburgh, Pa. It is located in the Oliver building and is in charge of R. M. Rush, who was formerly with the Deavo-Doyle Company. F. B. Allen, formerly connected with the Cleveland office of the Cooper-Hewitt Company, is also associated with Mr. Rush.

The Buffalo Brake Beam Company, New York, will open a branch office at Hamilton, Ont. A portion of the land occupied by the Hammant Steel Car Company has been leased, and the erection of temporary quarters is already under way. The business and staff of the branch office now located at Brantford, Ont., will be moved to Hamilton.

The Western Electric Company, New York, has taken over the business of the Cleveland Electrical Supply Company, Cleveland, Ohio, and has opened a branch office at 724 Prospect avenue, Cleveland, the former address of the supply company. H. A. Speh, formerly in the Buffalo, N. Y., office of the Western Electric Company, has been made manager.

W. O. Jacquette, formerly vice-president of Manning, Maxwell & Moore, Inc., New York, has been made vice-president of the American Shop Equipment Company, Chicago, with office at 30 Church street, New York. The American Shop Equipment Company handles shop devices, including oil furnaces for welding, forging, melting and annealing.

Richard J. Sheridan, formerly assistant to H. A. Fabian, manager of purchases and supplies of the New York, New Haven & Hartford, with office in Boston, Mass., has been appointed eastern agent of the Chicago Railway Equipment Company, succeeding C. P. Williams, resigned to go to the National Lock Washer Company, Newark, N. J., with office in Chicago.

Olin, Giberson & Hilands, Inc., eastern selling agents for the Sligo Iron & Steel Company, Connellsville, Pa., maker of iron bars for bolts; the Keystone Tube Works, Inc., Uniontown, Pa., maker of light gage tubes; and for the Central Tube Company, Pittsburgh, Pa., maker of conduits and pipes, have moved their offices from 2 Rector street, New York, to 30 Church street.

Stewart D. Anderson, eastern representative of the Standard Railway Equipment Company, Pittsburgh, Pa., with office in New York, and formerly with the Hutchins Car Roofing Company, Detroit, Mich., with office in Chicago, died in Richmond, Va., on September 5. Mr. Anderson was born in Buffalo, N. Y., in 1848, and had been with the Standard company for about 11 years.

Charles P. Williams, who has been eastern agent for the Chicago Railway Equipment Company, with office in New York, has resigned to become connected with the National Lock Washer Company, Newark, N. J., with headquarters at Chicago. Mr. Williams was formerly connected with the Chicago, Milwaukee & St. Paul, the Michigan Central, the Canadian Pacific and the Minneapolis, St. Paul & Sault Ste. Marie, and with the M. J. Holden Company of Montreal, Que.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has declared a dividend of 1 per cent. on the common stock, for the quarter ended September 30. Six months ago 1 per cent. was declared on the common stock. The common stock dividend is payable October 30 to stock of record September 30. The following statement was authorized by the chairman of the board of directors: The action of the directors means that the common is established on a 4 per cent. basis and will continue on a 4 per cent. basis unless there develop less favorable conditions than the present outlook indicates. Increases in the dividend will be subject to future consideration.

E. Harrison Symington, western agent for the T. H. Symington Company, Baltimore, Md., with office in Chicago, died in Baltimore on September 5, after undergoing two operations for internal injuries. About five years ago Mr. Symington sustained severe injuries from a fall from his horse, and the recent operations were due to that accident. He was 34 years old and was graduated from Lehigh University in 1898 as a mechanical engineer. He was a member of the Saddle and Cycle, the University, the Chicago and the Athletic clubs in Chicago, and of the Baltimore Country Club and the Maryland Club in Baltimore.

Charles E. Lee, general superintendent of the Boston & Maine, with office in Boston, Mass., has resigned to go to the Commercial Acetylene Company, New York, as general manager, with office in New York. Mr. Lee was born August 19, 1860. He began railway work in 1877 as an operator on the Boston, Clinton, Fitchburg & New Bedford, now a part of the New York, New Haven & Hartford. From 1879 to December, 1896, he was operator and train despatcher on the Worcester, Nashua & Rochester and its successor, the Boston & Maine. In December, 1896, he was appointed superintendent of the Worcester, Nashua & Portland division of the Boston & Maine, and in August, 1903, was appointed assistant general manager. On September 1, 1906, he was appointed to the position of general superintendent of the same road.

At a special meeting of the board of directors of the Cambria Steel Company, Johnstown, Pa., on September 26 last, William H. Donner, of Pittsburgh, Pa., was elected president, succeeding Charles S. Price, resigned; and J. Leonard Replogle, heretofore assistant to president, was elected vice-president. Mr. Donner was born at Columbus, Ind. His first important business engagement was as treasurer and manager of the National Tin Plate Company, of Anderson, Ind., which he organized in 1894; but he is perhaps best known as being responsible for founding the town of Monessen, Pa., which sprung up simultaneously with the organization of the National Tin Plate Company of that town. Both concerns were absorbed by the American Tin Plate Company in the latter part of 1898. Mr. Donner's next venture in the steel business was in the organization of the Union Steel Company, of Pittsburgh, Pa., which built a plant at Donora, Pa., and was responsible for the beginning of that town. The Union Steel Company consolidated with the Sharon Steel Company, of South Sharon, Pa. (now Farrell, Pa.) and was taken over by the United States Steel Corporation early in 1903. Mr. Donner will continue to live in Pittsburgh, where he has an office in the Frick building, but will spend part of his time at Johnstown. J. Leonard Replogle, the new vice-president, was born in Bedford county, Pa., May 6, 1876, and was educated in the public schools of Johnstown. He was just 13 at the time of the memorable Johnstown flood, from which he and his family barely escaped with their lives. The loss of everything made it necessary for Mr. Replogle to go to work, and he entered the employ of the Cambria Steel Company as an office boy. He served successively as clerk; shipper; assistant superintendent of the axle department; superintendent of the forge, axle and bolt departments; assistant to the assistant general manager; superintendent of the order department; assistant general manager, and assistant to president. Mr. Replogle is a director and a member of the finance committee of the Johnstown Trust Company; a director of the American Automobile Association; and a member of the American Electric Railway Association, the Western Railway Club, the Johnstown Country Club, the Johnstown Automobile Club and the Duquesne Club, Pittsburgh.


William H. Donner.


J. Leonard Replogle.

CATALOGS

BABBITT.—The Lumen Bearing Company, Buffalo, N. Y., has issued a catalog describing its various babbitt metals, including their characteristics and physical properties.

BRIQUETTING MACHINERY.—The United States Engineering Company, 80 Wall street, New York, as representative of Wm. Johnson, Armley, Leeds, England, is issuing a catalog which illustrates and describes several different designs of machinery for coal briquetting plants. Cross sections of complete plants which show the arrangement of the machinery, belting and conveyors that are recommended by this company under different conditions have also been included.

SECTIONAL STEEL BUILDINGS.—The Ruby Manufacturing Company, Chicago, has issued a new illustrated folder describing its line of sectional, portable fireproof steel buildings for a large variety or uses, including garages, boat houses, contractors' buildings, bunk houses, tool houses, engine houses, handcar houses and power plant buildings. These buildings contain no combustible material of any kind, the frames being built of heavy steel angles on the truss principle, designed for stability and durability.

VANADIUM STEEL.—A booklet is being issued by the United Steel Company, Canton, Ohio, which contains very interesting and valuable information in connection with tests of chrome vanadium steel. Illustrations are included showing the results of the different tests on springs, gears, axles, bars, etc., which convincingly indicate the ability of this material to withstand punishment. This booklet will be found valuable by the engineer who wishes to use this highly developed material and desires accurate information on the latest tests.

ACETYLENE WELDING IN LOCOMOTIVE REPAIRS.—A leaflet being issued by the Davis-Bournonville Company, New York, gives photographs and a brief description of a number of different repairs to locomotive boilers recently made in a large eastern repair shop where an oxy-acetylene welding plant is in use. These give the time required, the amount of oxygen consumed and the cost in each case. A report of a pulling test of welds on boiler plate indicates that, when properly made, such a joint is practically equal in strength to the solid sheet.

ACETYLENE GAS.—The International Oxygen Company, New York, has published bulletins 5, 6 and 7, which describe the methods and machinery used in generating acetylene gas; also the Eyeosee oxy-acetylene welding torches and practical hints and data for the use of operators. Leaflets have also been printed giving a report of tests of cells for the electrolytic production of oxygen and hydrogen; also an abstract of a paper concerning oxy-hydrogen as used in street railway construction and the I. O. C. oxy-hydrogen platinum melting process.

ORDER GUIDE FOR CAR PARTS.—The J. G. Brill Company, Philadelphia, Pa., is issuing Order Guide No. 201, which is intended for the convenience of the user in obtaining repair parts for any cars manufactured by the J. G. Brill Company, American Car Company, G. C. Kuhlman Car Company, John Stevenson Company, Danville Car Company, and the Wasson Manufacturing Company. On each left hand page of the book is an illustration of a part both complete and in detail, each section being numbered, while on the facing page is a corresponding number with the name of the part. The illustrations are all reproductions of photographs.

GRIP RELIEF IN BOLT HEADING MACHINES.—A folder is being sent out by the National Machinery Company, Tiffin, Ohio, which is confined to a discussion of the proper design for a spring grip relief or safety device to guard the machine against damage in case some object should get between the gripping dies and prevent them coming together. It has been customary on most machines to use an arrangement which employs either a bolt or shearing pin, or a spring arrangement. The disadvantages of this construction are pointed out in the folder, and the arrangement which automatically reseats itself and does not in any way impair the holding power of the grip, which has been designed by this company, is fully illustrated and described.

MODERN WELDED PIPE.—An interesting pamphlet illustrated in colors is being issued by the National Tube Company, Pittsburgh, Pa. It concisely, but fully covers the essential points in the manufacture of steel pipe and tubing from the iron ore to the commercial product. Methods of making lapp and butt welded tubing and pipe are both explained, as is also the method by which a uniform quality of steel suitable for pipe making can be obtained. This company manufactures its steel from the ore and uses a Bessemer product which is perfectly suited for its needs. Considerable space is devoted to the relative effect of corrosion on steel or iron pipes, and it is conclusively shown that the steel pipe or tube will not suffer by the comparison under normal conditions. The proper tools for threading pipe are considered at some length. This book will be found most interesting to all users of either pipe or tubes, and contains new information of considerable value.

MALLET ARTICULATED LOCOMOTIVES.—In Record No. 72 from the Baldwin Locomotive Works, Philadelphia, Pa., is found an excellent discussion of the advantages of the articulated type of locomotive in general, as well of the detail parts as designed by this company. Phantom views make the arrangement of piping and steam passages easily understood, and locomotives both with and without reheaters and feed water heaters are shown in this manner. Drawings and photographs of some of the more important details are also included. Several pages are devoted to instructions in the proper method of handling articulated locomotives. It is stated that if the wheels of the forward group slip frequently while those of the rear group do not, it is an indication that steam is leaking past the high pressure valves and that these should be examined for blows. Other similar instructions for break downs or troubles peculiar to this type are clearly explained. The latter half of the book is given up to descriptions, illustrations and dimensions of many different designs of articulated locomotives built by the Baldwin Works.

DIRECT CURRENT RAILWAYS.—An attractively bound book of 132 pages, devoted to direct current railways using pressures of 1,200, 1,500 and 2,400 volts, has just been issued by the General Electric Company, Schenectady, N. Y. The first part contains a number of tables comparing the costs of 1,200-volt systems to those operated at 600 volts. For this purpose four different systems are assumed each 100 miles in length, one operating 9,000 car miles per day with a schedule speed of 45 miles per hour for three-car trains and the other three operating 3,000 car miles per day with schedule speeds of 35, 25 and 15 miles per hour for one-car trains. Every possible cost is considered and the result shows that for all electrical costs, including operation, fixed charges for the 1,200-volt system would be but 84 per cent. of the 600-volt system in the first case, 86 per cent. in the second, 90 per cent. in the third and 94 per cent. in the fourth. Following this is a section devoted to illustrated descriptions of the apparatus for a high voltage direct current railway system, such as generators, motors, controllers, etc. Locomotives for operating on roads of this character are fully described, specifications of a number of examples being included. The remainder of the book is given up to illustrated descriptions of various examples of high voltage, direct current systems in all parts of the country. The book contains a large amount of valuable information on the subject and will be found of much interest and value to electric railway operators and others interested in electric traction.